TABLE OF CONTENTS

		Page	
List of Figures and Illustrations		ii	1/A5
Preface		iii	1/A6
Chapter One	General Background and Rationale of STARPAHC	1	1/A7
Chapter Two	Genesis of STARPAHC at NASA	17	1/C1
Chapter Three	The Indian Health Service	33	1/D3
Chapter Four	The Papago People	55	1/E13
Chapter Five	System Design and Evaluation	81	2/A3
Chapter Six	Summary and Conclusions	101	2/B10
Appendix	Publications about STARPAHC	ai	2/C8

JUL 1 1981

830-C NAS1.2:T23/4

TECHNOLOGY

COMPLETED
ORIGINAL

NASA / IHS / LMSC
STARPAHC
PAPAGO

SERVES THE PEOPLE

OFFICE OF RESEARCH AND DEVELOPMENT
TUCSON, ARIZONA

TECHNOLOGY SERVES THE PEOPLE

The Story of a Co-operative Telemedicine Project by NASA, The Indian Health Service and the Papago People

Prepared For The Indian Health Service, HEW
By
Dr. Rashid Bashshur
Professor of Medical Care Organization
School of Public Health
The University of Michigan

For sale by the Superintendent of Documents, U.S. Government
Printing Office, Washington, D.C. 20402
Stock No. 017-028-00009-0

A

TABLE OF CONTENTS

		Page
List of Figures and Illustrations		ii
Preface		iii
Chapter One	General Background and Rationale of STARPAHC	1
Chapter Two	Genesis of STARPAHC at NASA	17
Chapter Three	The Indian Health Service	33
Chapter Four	The Papago People	55
Chapter Five	System Design and Evaluation	81
Chapter Six	Summary and Conclusions	101
Appendix	Publications about STARPAHC	ai

LIST OF FIGURES AND ILLUSTRATIONS

		Page
Figure 1	Health Services Support Control Center (Sells Hospital)	4
Figure 2	Local Health Service Center (Santa Rosa Clinic)	5
Figure 3	Mobile Health Unit	6
Figure 4	Phoenix Indian Medical Center (Referral Center)	7
Figure 5	Map of the Papago Indian Reservation	9
Figure 6	Typical AHSFU System Configuration	21
Figure 7	National Telemedicine Network System Configuration	22
Figure 8	Indian Health Service Areas	36
Figure 9	Indian Health Service Organization Chart	38
Figure 10	Community Health Medic at Work in the Mobile Health Unit	45
Figure 11	Looking South from the Village of Ali Chuk	56
Figure 12	A Papago Community Health Representative Examines a Patient	64
Figure 13	The *Bith Haa* Model	67
Figure 14	The STARPAHC Relay Tower on Mt. Logan	72
Figure 15	Vaya Chin Village Serviced by STARPAHC	78
Figure 16	Pisinimo Village, Site of Mobile Health Unit Stop	79
Figure 17	Evaluation Information Reporting	95
Figure 18	Papago Leaders Inspect the Interior of the Mobile Health Unit	108
Figure 19	The STARPAHC Operator's Console	110
Appendix A	Outline of the Community Health Medic Program	49-53

PREFACE

This story of STARPAHC was written to document the planning and development process through which the STARPAHC system came to be. Typically, for projects like STARPAHC a variety of technical system descriptions, evaluation reports and technical performance analyses are prepared and disseminated by various methods. Often, however, the story of how the agencies and participants planned, designed, and developed such high technology systems is not documented — unless they fail. In this case the efforts did not fail and an advanced telemedicine system was developed, installed and became a routine part of a system of health care on the Papago Reservation in Southern Arizona. The participants in this process included a myriad of types of engineers, health professionals, system designers and researchers but, most of all, Papago people. The Papago people included providers of health care through the several Papago health programs who work in daily association with the Indian Health Service program on the reservation, members of the Tribal Council and the residents of the villages served by the STARPAHC project, the Indian Health Service and the Papago health programs.

Rashid Bashshur, with his long history of contributions to the field of health care and telemedicine, was a natural choice to write this story. The files of the Papago Executive Health Staff, NASA IMBLMS-STARPAHC Project Office and the IHS, ORD were opened wide for Dr. Bashshur and access to all the participants was made available. His story of STARPAHC may help to put to rest some myths: (1.) that technology transfer will *of necessity* adversely disrupt lifestyles and cultures, (2.) the systems analysis and engineering process is *of necessity* an impersonal process with no provision to respect the cultures and preferences of those involved, and (3.) only highly technologically sophisticated people can have useful input to the design and development of high technology systems.

STARPAHC continues today as an integral part of the Health Services Delivery Program of the Papago people. It continues to evolve and change in response to the needs of the providers and recipients of care. How this came to be is the story told by Dr. Rashid Bashshur.

Charles J. Erickson
Tucson, Arizona
July, 1979

Chapter One

GENERAL BACKGROUND AND RATIONALE OF STARPAHC

Introduction

This is the story of Space Technology Applied to Rural Papago Advanced Health Care (STARPAHC), a large scale telemedicine project conceived and sponsored by the National Aeronautic and Space Administration (NASA), engineered by both NASA and its contractor, Lockheed Missile and Space Company (LMSC), and assembled by LMSC. The project was jointly planned, implemented and evaluated with the active participation of the Papago people, the Indian Health Service (IHS), and the Department of Health, Education and Welfare (DHEW) (now the Department of Health and Human Services). It is a story that should be told because it may be a rare instance of a cooperative effort, that was actually brought to fruition, involving several federal agencies, private industry, and a group of Native Americans. Though these groups began with widely different interests, perspectives and modes of operation, they were able to develop an effective working relationship and a melding of approaches which led to the successful completion of the project. What made this possible was the apparent sharing of two common goals among these groups, namely, the improvement of health care among the Papago and the investigation of the merits of telecommunications in health care delivery.

The actual story of STARPAHC's development has never been fully understood and, therefore, appreciated except by the few people who participated in its design and implementation. Even the professionals who have reviewed and tracked every telemedicine project in the country had, during the developmental phase, very limited information about STARPAHC, as can readily be seen from its limited reporting in the published literature at that time. Indeed, the richness of this project in terms of its sophisticated design and advance planning were not matched by commensurate information dissemination activities. The reasons for this lack of early publicity are part of the developmental story of STARPAHC.

Due to the low profile of STARPAHC's development, the initial external opinions about STARPAHC generally reflected conjecture and/or misinformation. To be sure, early inquiries for information into such issues as procurement, site selection, and design specifications encountered formidable barriers. As it turned out, there was a formal agreement—much misunderstood by the telemedicine community—between the four primary parties, NASA, IHS, LMSC, and the Papago Tribe, stipulating that all information pertaining to STARPAHC could only be released with the expressed approval of all four parties. The intent of this agreement was doubted by the critics who took it as evidence of activities meant to be hidden from public scrutiny. In fact, outside observers who were unable to penetrate the clearance procedure were generally disaffected by it. Now, it is all in the past and no longer a relevant issue. Nonetheless, had these observers known that the procedure was established at the request of the Executive Health Staff acting in behalf of the Tribal Council in order to control potential abuse of information emanating from STARPAHC, their attitudes toward it might have been more positive. Indeed, the Papago Executive Health Staff wanted to be certain that the role of the tribe was not misunderstood by the public, and they viewed this clearance procedure as serving to assert their involvement in the design of the project as well as in the dissemination of relevant information. At the same time, it should be clarified that the ORD/IHS maintained a "low profile" policy with regard to the dissemination of information about the project. This policy was based on two primary considerations; the first was based on resource allocation and the second was a concern for the so called "Hawthorne" effect. With high visibility and publicity, the ORD anticipated becoming involved to an extent that might tax their limited resources, and the evaluations were planned to be minimally influenced by specific expectations of results to be achieved.

Interestingly, however, everyone who had an opinion on the subject tended to blame NASA for the secrecy; the most cynical categorized the procedure as a cover up for a blunder on the Sonora Desert. The reasons behind such negative attitudes are not clear, whether, for instance, they reflected an ideological position that was opposed to the expansion of technology into human services or whether it was a concerned response to NASA's attempt to enter the health care delivery field on earth. Later in this chapter the nature of the early reaction to STARPAHC will be analyzed in order to sort out myth from reality. Be that as it may, the early skepticism was overshadowed by diligent joint efforts of the federal agencies, private industry and the Papago to develop a sophisticated telemedicine system to serve the Papago people in the Sonora Desert.

Similar to other large scale efforts involving the active participation of several major actors, there can be different stories of STARPAHC depending on the vantage point of the actors. Our approach to the STARPAHC story is selective, perhaps as any approach must be, yet it is one of professional neutrality, and its focus is on the major actors: NASA and its contractor (LMSC) and the Papago and the Office of Research and Development of the Indian Health Service. The role of the Indian Health Service in the project has been almost inseparable from that of the Papago. And the role of Lockheed was defined, if not controlled, by NASA. As such, the ancillary roles of IHS and LMSC were placed in perspective. In effect, there were two main groupings: NASA and LMSC as the sponsor/contractor and the IHS and the Papago as the provider/ recipient. Yet, irrespective of vantage point, the story has a dual message: one addressed to the telemedicine audience (the professionals in health care and engineering who are exploring the efficacy of technologic organizational solutions to health care problems) and the other to the larger medical community.

For the telemedicine audience, the resounding message is threefold: the necessity for (1.) advance planning, (2.) definition of objectives, and most critically, (3.) the active involvement of the community for the successful development of such projects. Due to their inherent complexity and cost, telemedicine projects require particularly detailed planning of design, operation, and evaluation. However, no matter how carefully these projects might be designed, if they are not accepted by their users—both the providers and the consumers—they fail. In fact, community support can be translated into an effective demand for such services. Moreover, the early development of an evaluation plan is crucial. To be valid and to provide maximal information, the evaluation plan must not only be directed toward the specific objectives to be achieved by the project, but must also be developed prior to installation and operation. Some parts of it can be designed into the routine activities of the project, particularly in terms of collecting patient utilization data. Others, such as diagnostic reliability, must be evaluated periodically and under varied conditions.

For the medical care community, the crucial message derived here is that high technology applied to health care delivery is not necessarily antithetical to the humanist approach desired by many. Thus, the cultural attributes and the social preferences of the service population can and must be integrated into the design of high technology health care systems. The only reliable mechanism for accomplishing this goal is community involvement in the design process. Granted this is often difficult and time consuming, depending on the size of the potential service group and the attendant social order complexity, and it requires the development of reliable communication channels with the community. Nonetheless, the development of telemedicine or other technologically-based systems that are aimed at helping people overcome spatial/temporal barriers to the receipt of health do not have to be attained care at the expense of significantly changing preferred lifestyles, unless of course that change is a desirable end in itself. That is to say, telemedicine has the capability of supporting any prevailing life style for a given social order, both domestic and foreign. However, many developing countries may find telemedicine especially suitable since they already have the requisite technology, especially in their air force and airline personnel. They may lack medical personnel and referral services in their rural areas. Satellite relay stations would also enable direct audio-video communications with several medical centers in the United States or other areas of the world. Indeed, this may yet prove to be one of the major directions in the future of telemedicine.

The STARPAHC Concept

The origin of the STARPAHC concept lies in NASA's primary mission of space exploration and the development of an Integrated Medical and Behavioral Laboratory Measurement System (IMBLMS) to provide routine and emergency medical services to astronauts during orbit, and most importantly, during periods of long duration space flight. The early concern about the ill effects of zero gravity on the well-being of astronauts, subsequently found to be largely exaggerated, was replaced by the necessity to develop comprehensive health care capability for future on-board systems planned for orbital laboratories and interplanetary flights.

More detail will be provided in the following chapter concerning the IMBLMS project and the subsequent plan to test the applicability of IMBLMS spawned concepts to earthbound health care delivery in remote areas, and the development of STARPAHC. At this point, only the broad outline of the concept will be described in the hope of providing a clear and concise perspective on the project.

The STARPAHC project was conceived and developed by NASA and its contractor as an earthbound "test bed," with two sets of objectives in mind. One set of objectives, the more germane for NASA, was the development of health care systems particularly suitable for future long duration manned space flight. Since it may not normally be feasible to have various medical specialists and full medical facilities on board during the flights, it becomes necessary to provide some medical training to astronauts and to develop telecommunications links between the travelling astronauts and the fully staffed and equipped command station on earth. The other set of objectives pertains to the efficiency of similar communication systems for implementation in health care delivery in remote areas where access to medical care is a serious problem. In this case, the project is aimed at the determination of the effectiveness and applicability of this system, its elements, and protocols for improving health care delivery in such areas. Each of these sets of objectives contains several specific subobjectives, which will be discussed later. Though much larger in proportion and complexity, the STARPAHC concept might also serve as a good example of a spinoff of space technology, such as Teflon, new metal casting techniques, and meteorological applications.

MOUNT QUIJOTOA RELAY STATION

Figure 1

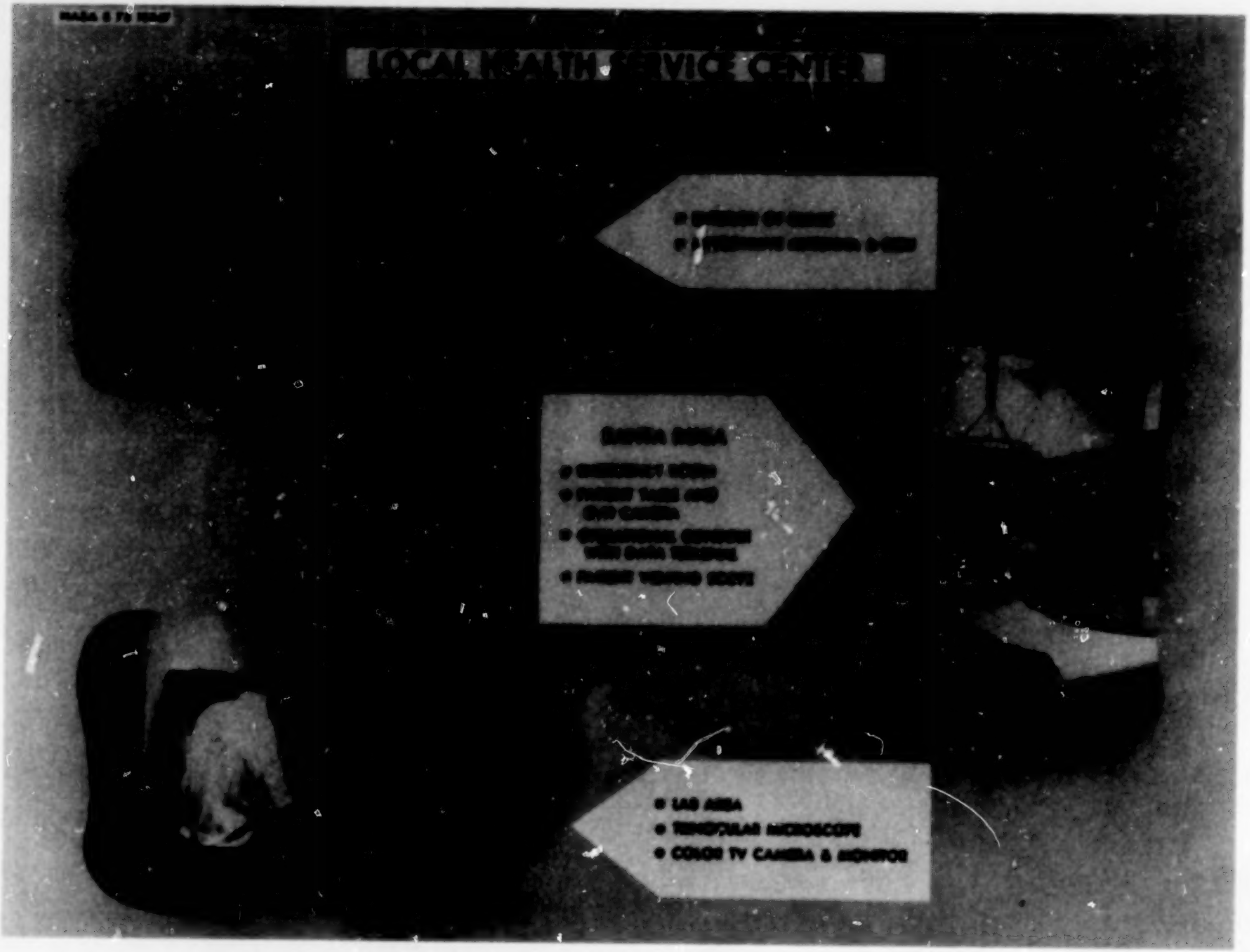

LOCAL HEALTH SERVICE CENTER
● LAB AREA
● TRINOCULAR MICROSCOPE
● COLOR TV CAMERA & MONITOR

Figure 2

BLANK PAGE

BLANK PAGE

Figure 3

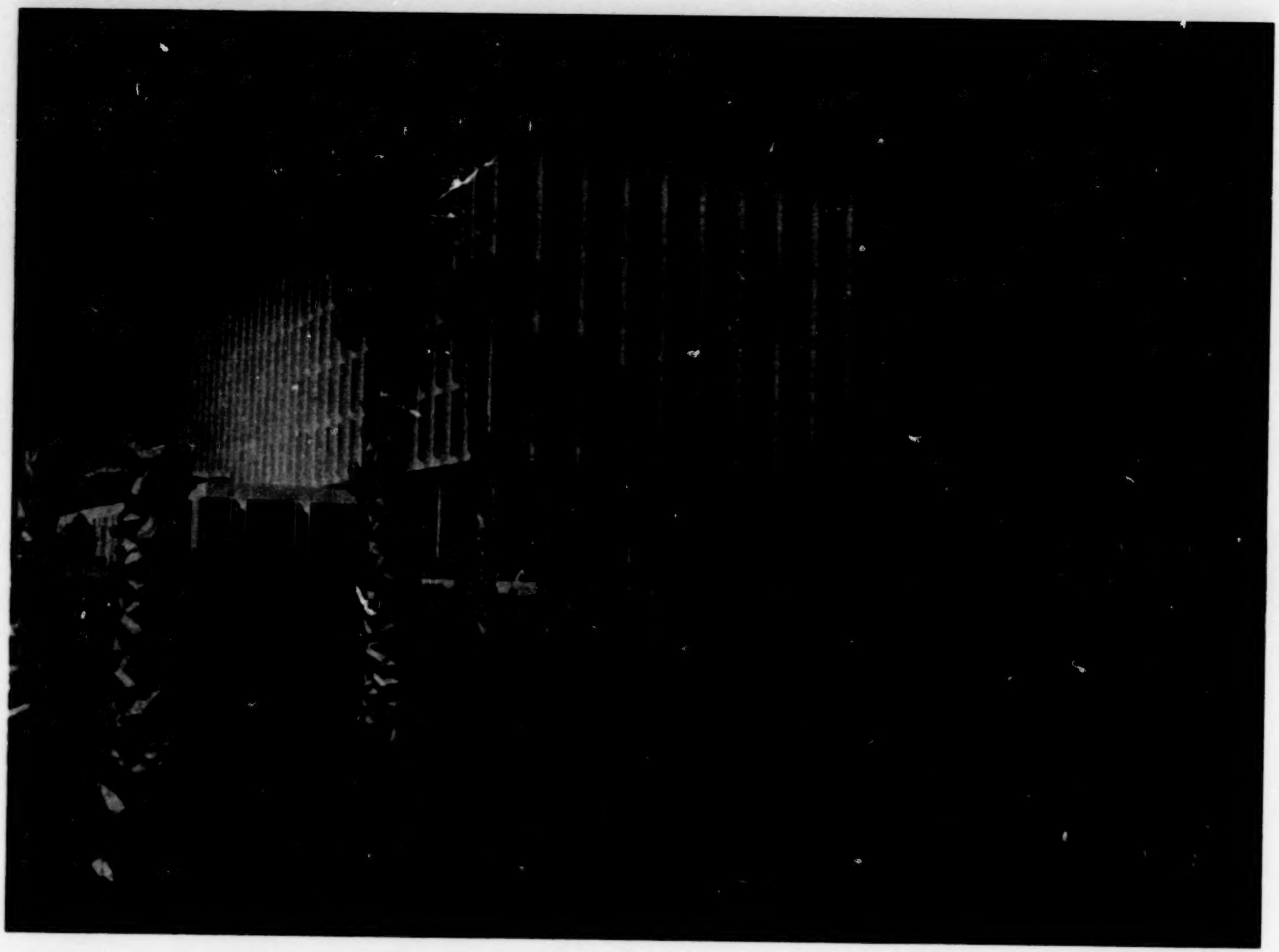


Figure 4: Phoenix Indian Medical Center

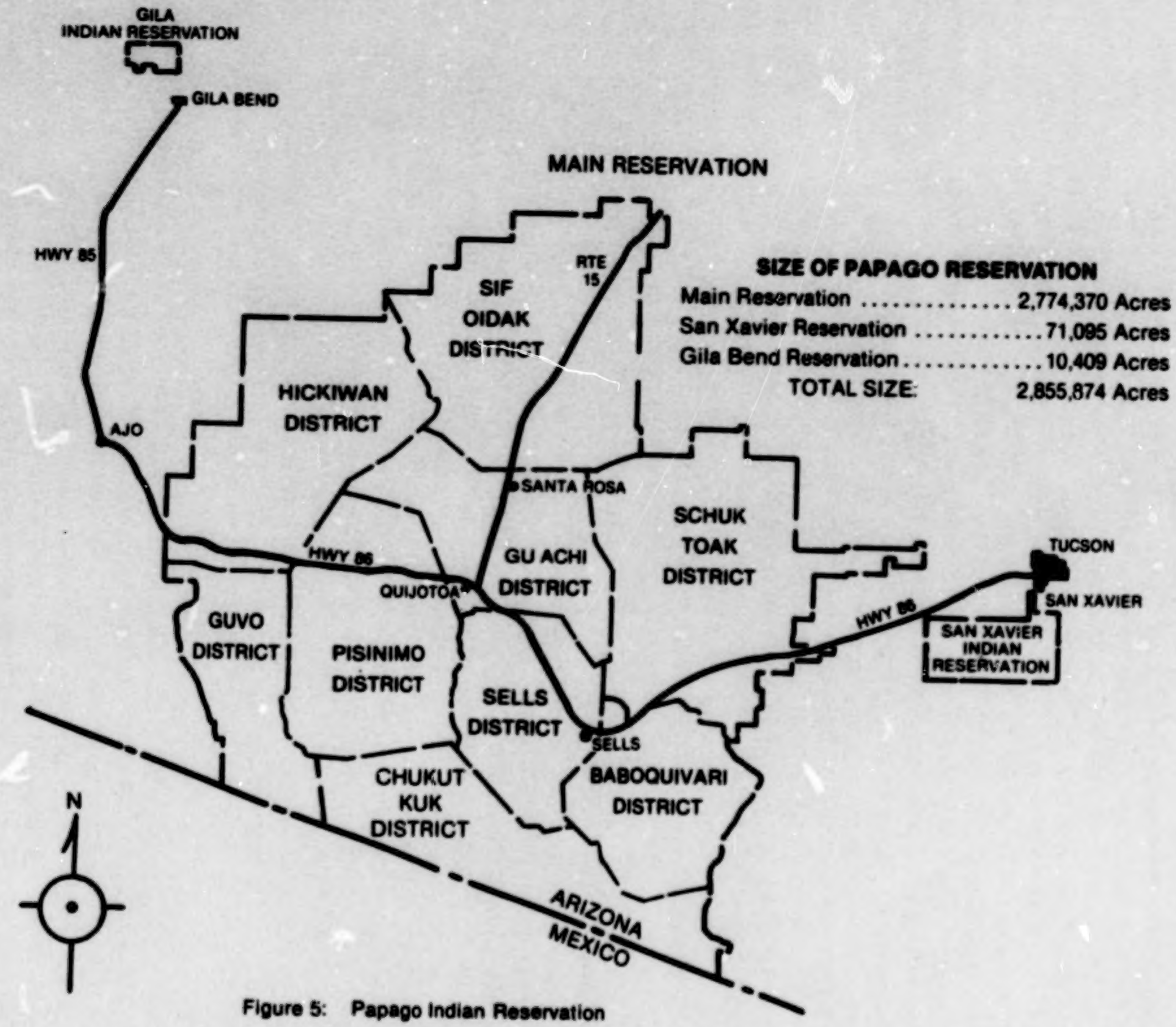
The basic configuration of the STARPAHC concept includes the establishment of a hierarchical multi-site delivery system—including both stationary and *mobile* service units—that is integrated via telecommunications, telemetry and a computerized data system. It consists of a full medical service central clinic (located at the Sells Indian Hospital, Figure 1) a fixed satellite clinic (located at Santa Rosa, Figure 2), a mobile health clinic (Figure 3) that travels a predesignated route covering the most isolated districts in the reservation to the west, and a hospital-based specialty referral center at Phoenix (Figure 4). Specially trained non-M.D. personnel (Community Health Medics—CHMs) serve as primary care providers at the satellite and mobile clinics, supported and, if need be, supervised by the physicians located at the central clinic (through the communications system) to specialist consultation at the Phoenix Indian Medical Center. Additional support services include a network of Tribal Outreach Workers; the Community Health Representative (CHRs), Nutrition, Disease Control, Alcoholism and Mental Health Workers, distributed throughout the region. A minibus is available to transport patients to the satellite and mobile clinics, and a portable suitcase-size emergency service unit can be used in the field and in cases where the patient is bedridden or immobile. All tribal outreach personnel and their activities are managed by the tribe through its Executive Health Staff.

The Telemedicine Concept

The perspective from which telemedicine is viewed here and the framework applied is based exclusively on its systemic qualities, as a comprehensive delivery and communications system. Viewed in this manner, telemedicine provides the capability of communication between a physician and a remote patient for diagnosis and/or treatment, as in telediagnosis; between a supervising physician and a non-M.D. provider as well as between a general practitioner and a specialist, as in teleconsultation; or between a medical educator and group of providers or patients, as in tele-education.

While there is not clear consensus among professionals involved in telemedicine as to a precise definition of a telemedicine system, the predominant view is that it consists of a comprehensive system for the provision of a broad spectrum of health services that has as a major component, and relies heavily on the use of telecommunications to bridge the distance between patient and physician. Other system prerequisites include multi-site delivery settings with non-M.D. providers staffing the remote satellite clinics, and the attendant development of an organizational structure suitable for this mode of health care delivery. Hence, without these prerequisites, by definition and implication, there can be no "telemedicine system" as such, rather, merely the imposition of a communications technology onto an existing health care delivery arrangement. Under such circumstances, the telecommunications component represent nothing more than an extension of the telephone.

The video medium allows for a variety of temporal frames appropriate to the communication task that may be required or needed. This includes "real-time" as in interactive or two-way television, less than or slower than real-time as in slow-scan television image and hard copy. Medical data such as radiographic images and patient records can also be transmitted and retrieved. Moreover, in a telemedicine system the electronic components permit signal enhancement, and hence, additional information can be gained. For instance, microscope attachments, electronic stethoscopes and zoom lenses may increase the amount of information available to the physician as compared to a conventional face-to-face viewing of the patient or X-ray film.


GILA
INDIAN RESERVATION
GILA BEND
HWY 85
AJO
MAIN RESERVATION
RTE 15
SIF OIDAK DISTRICT
HICKIWAN DISTRICT
SANTA ROSA
SCHUK TOAK DISTRICT
GU ACHI DISTRICT
HWY 86
QUIJOTOA
GUVO DISTRICT
PISINIMO DISTRICT
SELLS DISTRICT
SELLS
TUCSON
SAN XAVIER
HWY 86
SAN XAVIER INDIAN RESERVATION
CHUKUT KUK DISTRICT
BABOQUIVARI DISTRICT
ARIZONA
MEXICO
N

SIZE OF PAPAGO RESERVATION

Main Reservation	2,774,370 Acres
San Xavier Reservation	71,095 Acres
Gila Bend Reservation	10,409 Acres
TOTAL SIZE:	2,855,874 Acres

Figure 5: Papago Indian Reservation

More could be said about the general characteristics of telemedicine. However, the immediate concern is the evolution of the STARPAHC system which had all the prerequisites to make it a viable telemedicine system: (1.) It was located in an environment in which access to medical care was a serious problem, a sparsely populated Indian reservation in southwestern Arizona covering approximately 4300 square miles, less than 10,000 persons residing in 75 small villages (see Figure 5 - map of Papago Indian Reservation). For some of these people, the journey for medical care had always been an all day affair, most often including an uncomfortable trip on the bus and a long wait at the clinic, and, even then, available only on certain days. The specific service area covered by the project was selected by the tribe on the basis of its locational disadvantage, that is, it has been difficult for many patients in that region to reach a physician at the Sells Service Unit within a reasonable time or distance. (2.) The Indian Health Service and the Papago Executive Health Staff had already developed an ongoing working relationship to provide needed medical, health and environmental services on the reservation. Hence, there was already an established delivery organization with a regional responsibility for the entire reservation that was suitable for a multi-site delivery system, and the community was willing and able to embark upon and support the telemedicine project. (3.) The Indian Health Service had already trained several CHMs who were capable of assuming clinical responsibilities for patient care under the supervision of a physician. (4.) The Phoenix Indian Medical Center was available to facilitate the centralization of referral functions for specialized tertiary care. Therefore, there seems to have been a good fit between the characteristics of the area, the needs of its population, and the existence of an effective multi-site delivery organization already in place on the one hand, and DHEW's and NASA's search for a suitable test site for the project, on the other.

Early Reaction to STARPAHC

When the news of an earthbound test site for the IMBLMS* concept first reached the telemedicine community, reaction was varied. On the positive side, a few telemedicine advocates looked forward to NASA's involvement with telemedicine as a potential boon to the "movement." It was also widely recognized that NASA's technology was far superior to anything else available in the market, and that its use of system design could set desirable standards for others to follow. Nonetheless, the critics outnumbered the supporters during this early stage. These negative reactions are briefly reviewed here as part of the explanation of the history of the attitudes that evolved coincident with STARPAHC's evolution. This discussion might also serve to illuminate some of the intellectual climate in telemedicine at that time. Perhaps the reasons why NASA was suspect during the early stages of STARPAHC will also become clear as the rest of the story unfolds. However, it may be appreciated that some of the disquiet was aided by the enacting clearance procedure, explained earlier.

*As will be explained later, NASA developed the IMBLMS concept and program for future manned space flight. The design concept which evolved out of IMBLMS was called the Area Health Services Field Unit (AHSFU). The project title and acronym was changed to STARPAHC after the Papago Reservation was chosen as the test and demonstration site at the request of the IHS and the Papago. IMBLMS was not descriptive of the nature of this project either in view of the plan or its implementation. STARPAHC was chosen by the Office of Research and Development of the IHS in consultation with the Papago Executive Health Staff with the express purpose of indicating the presence of an advanced health care system on the reservation, and that telecommunications will be installed to support that system.

Early criticisms revolved around the following issues: (1.) an excessive emphasis on technology in health care delivery; (2.) misdirection of NASA's basic space mission (what does it have to do with health care delivery here on earth?); and (3.) the selection of LMSC, an aerospace company which, despite some notable achievements in clinical management information systems, had limited experience in the design of health care programs. All that was known at that time was that LMSC had received a large contract understood to be between six and seven million dollars to develop a health care plan utilizing advanced telecommunications technology, including interactive television, telemetry, and computerized systems. Actual funds spent were about half that amount to be explained in Chapter Two. The broad outlines of the AHSFU concept were introduced by NASA as part of its public information activities, and it looked impressive at least to some people in the telemedicine community. Yet, only few in that group were convinced that LMSC and/or NASA had the experience to design and implement earthbound health care systems. Another factor of crucial significance to this project was the familiarity of ORD/IHS personnel with systems and health care concepts. This was to play a major role in the project as it moved through design and implementation processes.

Both NASA's entry into the health care delivery field and the contract with LMSC to develop the telemedicine hardware were viewed with skepticism. The nature of these negative attitudes deserves some attention and more details are in order. The size of the budget was beyond the scope of any other project in the country, and it was generally assumed that federal aid to the "ailing" Lockheed was probably the major reason and the distinction between LMSC and Lockheed Aircraft Corporation (LAC) was not understood. LMSC is separate from LAC, and it has, in fact, consistently had profits in recent years. On the other hand, while the amount budgeted by NASA appeared large to some people, it was indeed quite small relative to the operating budgets of either NASA or LMSC. Actually, the project may not have had any immediate financial appeals to LMSC unless it expected to open new market opportunities of much wider scale. The level of skepticism was heightened after the selection of the Papago site was announced, to be explained below. The clearance procedure mentioned earlier did little to allay people's misgivings about this project. The only widely available information was a brochure put out by LMSC with full color illustrations and printed on expensive paper. If this brochure was intended to serve as good public relations, then the opposite effect was probably achieved. Twenty months after the project started, NASA published a brochure accurately descriptive of the STARPAHC project. This brochure was prepared with extensive ORD/IHS and Papago review.

Most of the criticisms of STARPAHC by some of the telemedicine field, can be summarized in three related points:

1. *Technologic overkill.* The technology that NASA intended to install in the desert was not commensurate with the needs of a simple style of life characteristic of the Papago. It was indicated that a more basic or simpler technology such as a few telephones, negotiable roads and a well-equipped ambulance could achieve as much access to health care, if not more, than the expensive equipment in this project.

2. *Exploitation of the Papago.* Some critics insinuated that STARPAHC may be yet another example of an Indian group being exploited while an agency of the federal government was getting credit for a "good deed." The nature of the exploitation was explained as potential violations of human rights, people being subjected to experimentation without free informed consent, or that sensitive data gathered on people could be divulged to sources that could abuse the information. These critics doubted that the Papago could be

meaningfully actively involved in either the design or implementation of such a technologically complex project, since they could not understand the sophisticated hardware designs.

3. *Misallocation of Funds.* Still other critics believed that the Papago could have been better served if the funds were given to them directly or to IHS to allocate to their own programs as they saw fit to meet health care needs. That is, the six million dollar figure that was believed as the budget for the project could have provided the 3,000 potential users of the STARPAHC system about $2,000 per person, enough to buy a comprehensive health care package for several years. Indeed, the Indian Health Service was already providing health service to the reservation Indians and it was assumed to be of good quality. These critics, therefore, questioned the wisdom of allocating a large sum of money ostensibly to improve the delivery of health services to the Papago without substantially adding to its manpower or facilities, even if the service potential through telemedicine may be increased.

These were the major types of criticisms that were leveled, most of which were made immediately following the announcements of the selection of LMSC as the contractor and of the Papago Reservation as the test site. The criticisms ranged from stressing the limited benefits of this project to the Papago, through doubting the usefulness of advanced technology in a rural setting that is relatively isolated from the mainstream of American life, to the view that the project was intended to give the Lockheed a shot in the arm. Yet, underlying each of these criticisms were some questionable assumptions. The most critical deals with the flexibility and source of the funding. That is, it cannot be assumed that the funds available for this project should have been reallocated in any way seen fit to improve the delivery of health services on the reservation, or anywhere else. Indeed, there were no options—the funds came from NASA, not from DHEW. These funds were allocated by NASA's management for a NASA project in conjunction with DHEW. Moreover, the cost to IHS through the "rent" for housing the equipment and project personnel was inconsequential and the use of existing medical and support personnel did not tax the service unit on the reservation. These costs were more than offset by adding the communications system, the closing of one fixed satellite intermittent clinic (now served by the mobile clinic), and the employment of Papago staff on the project. When the test period was over, NASA would also leave behind expensive equipment that could become permanent fixtures at the service unit, thus expanding their communications and service capabilities. As will be explained later in this report, the Papago regarded the coming of this project to their reservation not as a mixed blessing but rather as a necessary and much needed communications and medical care system, something wished for a long time. The concept of telemedicine has strong appeal to the Papago because it enables them to reduce the problem of travel to the service units while allowing access to specialists. But it is likely that its strongest appeal for the Papago leadership is its adaptability to their culture. Indeed, one of its basic virtues is helping them maintain their culture and style of life while being able to receive the benefits of Anglo medicine, when needed. This will be discussed more fully later in this report.

Outside the Papago Reservation, the basic question about STARPAHC concerns its exportability, because, regardless of the specific benefits that might be accrued to the Papago in their desert environment, the question of its general applicability, in whole or in part, to other areas of the United States or other countries is of supreme concern to health care professionals. Hence, its real significance is considered to be its generalizability as a means to provide easier access to health care and the test of its generalizability to be based on costs and benefits.

Comparison to Other Telemedicine Projects

During the early 1970's, the telemedicine concept was gaining credibility among some health care professionals as (a.) a clinically feasible and (b.) potentially cost-effective technologic response to acute problems of medical manpower shortage and an uneven distribution of specialized health care manpower and facilities in certain areas of the United States. A number of telemedicine projects were installed with funds from several federal agencies including DHEW, the National Science Foundation (NSF), NASA, the Office of Economic Opportunity (OEO), and the Veteran's Administration (VA). With the exception of NASA, all the other agencies provided the funding for public and private non-profit organizations to develop and evaluate their own projects, with little or no interference from the granting agencies. This procedure is typical of the conduct of these agencies, and it is perhaps as it should be. However, the role of agencies was concommitantly limited by virtue of non-interference. They could not significantly influence the outcome of telemedicine research nor obtain the necessary information that is required for a meaningful determination of the true merit of this system of delivery. When their work was completed, the data they provided did not answer the crucial questions about the justification of future funding of similar projects or the need to redesign them into more efficient and cost-effective systems.

Although sharing with other projects the basic qualities of an appropriate telemedicine system, STARPAHC also had several distinct characteristics setting it apart from other telemedicine projects. Not only was it the largest in the terms of technical design and volume of funding, but it was also the only one that was fully conceived and basically designed by its sponsor prior to its assembly, implementation, and evaluation. That is, NASA had a well worked out design concept but the actual design process was carried out as a joint effort with LMSC, the ORD/IHS, and the Papago. Its evaluation plan was developed long before it became operational; the medical evaluation plan was developed by the Office of Research and Development of the Indian Health Service (ORD/IHS) in cooperation with NASA and the Papago; the hardware and technical evaluation was planned by NASA and LMSC, with input by ORD/IHS and the Papago. Moreover, baseline data on the potential STARPAHC service population were routinely compiled prior to project implementation, and hence before/after health status and other measures such a utilization rates and accessibility factors were available.

To be sure, the history of STARPAHC is not tantamount to the history of telemedicine in the United States. Several telemedicine projects were started long before NASA's entry into the field. Hence, there were simultaneous parallel developments both at NASA and in the private sector, both stemming from the idea of extending clinical capability through telecommunications and non-M.D. providers. Bio-medical and physical scientists at NASA were impressed with the analogy between providing medical care to astronauts in outer space from an earth station and the provision of medical services to people in remote areas here on earth. While these developments were taking place at NASA, the other earthbound research and demonstration projects were seeking technologic answers to health care problems of underserved populations in rural and ghetto areas as well as of confined persons in nursing homes or penal institutions.

Many telemedicine projects begun in the early seventies were discontinued because they were not self-sustaining. Some were hastily conceived, almost assuring their eventual demise. In some instances this is not surprising since they were implemented without a clear definition of mission, an identification of the specific niche they would occupy in the existing health care system, or the unique contribution they would make to it. Moreover, the serious questions dealing with the economic viability of this mode of practice—reflecting either effective demand by providers and/or consumers or reliable funding source—were not addressed. At the same time, few of these projects were designed as self-limiting experiments without intention of continuation beyond the experimental stage. Of course, many of these pioneering projects have individual stories that probably deserve to be told.

The experience of these early systems are significant in the history of this era in telemedicine. It may be instructive to analyze the underlying reasons for the failure of some of them before reaching fruition. The concern is with the common denominator in their shortcomings rather than with the idiosyncracies or the specific reasons that can be cited for the failure of a given project. In so doing, the purpose is not to disparage the efforts that went into the trials and experimentation of this era, but rather to identify the kinds of problems usually encountered in the early stages of the application of a new technology that outpaces the development of social organizations to deal with it. The shortcomings shared by these projects reflect limitations in the state of the art as well as adequate planning. They can be summarized as follows:

1. There were repeated and sometimes insurmountable *technical failures* of the equipment, primarily in the ground surface relay stations. Satellite technology obviates this problem today, transmitting more reliably and more economically;

2. Several projects suffered from *inadequate system design,* primarily improper consideration of the basic organizational structure of telemedicine as a delivery system with unique capabilities, or use of technologic "gadgetry" without regard to the requisite organizational structure needed for its application.

3. Another factor that was common to most projects was the incomplete or *inadequate involvement of one or more of the key actors* — providers, developers, and/or users — in the design of the system.

4. Finally, the issue of *long run economic viability* was not seriously addressed by many of these projects. Few had intended to demonstrate cost-effectiveness although the consequent decisions of the funding sources to discontinue sponsorship were based largely on cost-effectiveness.

Exportable Lessons

There are several exportable lessons that can be derived from STARPAHC. Perhaps the most important ones deal with: (a.) community involvement, (b.) system design and implementation, and (c.) evaluation. In addition, there are, of course, the specific technical configurations and components that might be replicated elsewhere at cost effective levels. For instance, it may be found that some of the "expensive" equipment can be eliminated from the system configuration without significant diminution of its overall performance. In fact, the major candidate for such reduction is the "real time" interactive television and its substitution with slow scan. Other technical components may be substitutable with less costly components. But the downward trend in the cost of some of the equipment that also corresponds with dramatic improvements in their technical performance suggests that such analysis may not have long term validity. In other words, if the basic assumptions on which these arguments are based continue to change, then no realistic plans can be made on past data. In effect, calculations on future costs of various configurations of equipment will be of limited value as long as the design and cost of equipment continue their current mixed trend. Eventually, satellite technology and fiber optics are bound to make interactive television ubiquitous like the telephone, and much of the arguments about bandwidth will become academic. The questions that will probably remain valid are those that deal with the process necessary for the successful implementation of such projects, not only in rural areas but in urban areas and in countries as well. Telemedicine is already being considered by other countries who wish to develop their own systems or to build communications links between themselves and medical centers in the United States. Finally, NASA learned a number of lessons in the design of health care arrangements for its space shuttle, orbital laboratories, and interplanetary travel.

In brief, the basic exportable lessons from the STARPAHC project for earthbound applications can best be presented as the process by which new large scale technologic programs can be successfully introduced into the community. This process is predicted on the assumption that *the community and its needs come first and that whatever technology is to be adopted or developed is sought only because of its capacity to serve those needs.*

1. The starting point is the identification of the specific needs of the community to be served, particularly those needs most amenable to satisfaction through technologic applications. Thus, the first order of business is to ascertain what it is the community needs and what aspects of its need can be addressed by technologic innovations. This involves a detailed assessment of community needs, a comparative analysis of the merits of various configurations of technology and manpower, and a determination of the most appropriate set to fit those needs.

2. The next step is to determine the nature of the organizational structure that is most suitable for a successful implementation of that new technology. The primary concern of private industry is to expand the technology and to press it to endless horizons because that is where their payoff is. In its quest for expanding the technology and the excitement of creation and invention, private industry and maybe government could become insensitive to the human dimension. What is essential, therefore, is a clear determination that technology could be reasonably expanded to the limits of the social organization that will handle it, and that social organization is slow in adapting to technologic changes.

3. The third stage involves the assessment of the specific environment and the cultural constraints to which the project will be introduced. The community has to be involved in a meaningful way in the design process if the acceptance of the project is to be assured. This does not imply turning community representatives into amateur engineers or health care specialists. But it does mean that people have to be fully informed of the specific nature of the project, and they should be provided choices between the alternatives that might be available to them.

4. Finally, the system configuration in both technical design and staffing arrangements has to be planned in sufficient detail. As well, the evaluation plan, reflecting the objectives of the project, has to be developed prior to the operation of the system. Establishment of baseline data prior to operation can also enable valid assessment of project impact.

Conclusion

The STARPAHC project was developed in full view of and involvement by all its participating organizations, including the Papago people. At the outset, an exacting clearance procedure for the dissemination of information about the project caused concern on the part of some observers of possible excesses on the part of NASA. The aim of this report is to document its evolution and the process of its development. Other publications have resulted from the evaluation efforts underway, and they address the specific issues of the efficacy, acceptance, and cost effectiveness of the system.

The telemedicine field is passing through yet another critical period in its evolutionary process. The findings to be reported by NASA and IHS about STARPAHC, as well as the other telemedicine projects in other parts of the country, are likely to have profound influence on the funding of similar undertakings, at least in the immediate future. This may be even more true in the case of STARPAHC because of its size and sophistication. Results reported by other telemedicine projects to date have been largely inconclusive, some suffering from significant limitations in their research design such as inadequate experimental design, lack of control over extraneous influences, insufficient duration for testing purposes, and lack of meaningful hypotheses—as to render their findings for the most part irrelevant. One necessay aspect of these evaluations that has been largely ignored in these efforts is the documentation of the developmental process. It is hoped that this story will help fill this void.

Chapter Two
GENESIS OF STARPAHC AT NASA

Introduction

The origin of the telemedicine concept at NASA can be traced to the concern during the late '50s and early '60s about the potential ill effects of zero gravity and other space flight environment hazards on man's health during space flight. At that time space travel was an untested concept, its effects on man unknown, but assumed by some to be serious. Initially, NASA simulated outer space effects in the laboratory wherein intensive pretesting and measurement of bodily responses were conducted. Pioneer flights had animals on board, wired to remote monitoring equipment and carefully observed by scientists. These early experiments suggested that human life would not be jeopardized under the conditions of zero gravity. Yet, despite these encouraging results, NASA sought to achieve maximal assurance that no untoward fate be met by the astronauts, and that, in an emergency, the astronauts could be quickly returned to earth. To this end, NASA and industry teams representing medical and biological science as well as engineering studied various problems of man's behavior and life support requirements in isolated and exotic environments. This spurred the development of the appropriate technology for the continuous monitoring of essential body functions and the capability for audio-video telecommunications, as well as efficient flight abortion and retrieval contingencies. In brief, the need to keep close watch over the astronauts during the early stages of space flight led to the development of telecommunications designs and technology aimed at establishing a link between the traveling astronauts and the physicians and other biomedical, behavioral and physical scientists in the command station on earth.

Experience proved that much of the early concern was not totally warranted since the effects of zero gravity were of limited short term consequence. Moreover, the space capsule proved to be a reliable vehicle well-equipped with life-sustaining support systems. Hence, the continous monitoring activities were subsequently reduced to monitoring only high activity or high stress periods during flight.

Though not by plan and in a simplified version, the general telemedicine scenario was essentially enacted during space flights. The basic scenario shows an astronaut in a space capsule, remotely monitored and recieving medical attention via telecommunications from the physician at the command station on earth. A physician can observe the astronaut on the television screen and can analyze the data on remote display equipment which shows vital signs and other relevant information. Specialist consultations are made as necessary. Medical advice or direction can subsequently be relayed to the capsule so that appropriate action can be taken. Moreover, medical supplies were carried on board, and the astronauts were trained to conduct certain diagnostic tests. Drawing blood proved to be traumatic for some.

It was only a matter of time before the larger context of telemedicine was percieved. This scenario proved to be equally applicable to a patient recieving medical attention from a physician while both were earthbound, but remote from each other. Thus the utilization of interactive telecommunications technology aided by telemetry and computerized data systems added a new dimension to the delivery of health services, extending the capability of the physician beyond the geographic or physical bounds determined by "co-presence". The physician would have direct access to crucial information about the spatially remote patient, including the ability to ask questions, visually observe abnormalities, and request specific symptoms of problems encountered. Indeed, it became obvious that, through this medium, the physician could obtain all the necessary information about the patient except tactile knowledge, and even this could be derived secondhand from the patient or lesser trained health professional.

This was the beginning of telemedicine at NASA. Its feasibility for a one-to-one relationship was demonstrated, i.e., direct access between patient and provider was possible via telecommunications without compromising the well-being of the patient. Although this was a crucial stage in the evolution of the concept, it proved only its feasibility, that it could be done, not that it was a viable system for health service delivery. Further, this may be all that could have been reasonable to expect since NASA's primary mission was space exploration, not the development of health care systems on earth. In addition, during the earlier short term flights, critical conditions could be resolved by bringing the astronauts back to earth for a complete treatment, thus lessening the need for sophisticated telemedicine capabilities.

As soon as NASA embarked on developing plans for the Space Station and long duration interplanetary travel, it focused attention on the health needs of space travelers, since it would not be feasible to bring astronauts or other spaceship occupants back for either emergency or routine care. Thus, there was a need to develop comprehensive remote care systems to provide both preventive and curative services. No longer could the focus of a telemedicine system be solely upon the intensive care model of continuous monitoring as predominated in the early stages of flight. It was futher realized that it would not be possible to place physicians on board every flight or to fully equip each space vehicle with elaborate medical equipment.

If the missions were to be successfully accomplished, the design of such systems had to be predicted on the following assumptions:

1. A variety of health needs may be encountered during long duration flights, and it is not always feasible to bring the travelers back under those conditions.

2. Although it may be possible to place physicians on such flights, there may be a need for consultations with others, particularly specialists.

3. The process of care must be defined in a specific and precise manner so that a non-M.D. provider with limited medical training could perform most of the anticipated medical services under the supervision of the remote physician. This would require the development of explicit clinical protocols which specify operational procedures in detail, including the symptoms that call for the immediate attention of the physician as well as the specific conditions under which consultation with the physician will be either required, advisable or not required.

A program designed to meet the need for laboratory measurement capability of human behavior and physiologic relations in space was the Integrated Medical and Behavioral Laboratories and Measurement Systems (IMBLMS), a major landmark development at NASA. The equipment could also be used for clinical purposes if the need arose; a beginning of telemedical delivery capabilities. Private industry was involved in several aspects of this program, LMSC and General Electric having significant roles. However, NASA's high hopes for this program were thwarted when the funding for the Space Station was halted by the Congress of the United States. Hence, it seemed that IMBLMS was doomed after considerable effort had gone into its design and development. In point of fact, because of its size and complexity, the feasibility studies and design work was divided into four phases (A, B, C, & D). The first two phases (A & B) had already been completed prior to the congressional action to cut the funding of the parent space station.

The opportunity to utilize some of the technology and designs that were developed for IMBLMS arose in 1971, when NASA, along with other federal agencies, was requested by the President's Domestic Council to make recommendations concerning the solution of the most pressing national problems. NASA's scientists and engineers decided to concentrate their efforts in the area of high technology and system design, a logical response in view of the major thrusts of their achievements. NASA addressed two recognized national problems, health care and urban housing, since these were two areas in which NASA felt they had especially appropriate expertise and sophisticated technology. Following is a brief review of NASA's answer to critical problems of health care delivery; equity of access, quality and cost.

Response to National Need

NASA's interpretation of its challenge in the health care area revolved around the following four parameters:

1. equity in access (from the point of view of the recipients of care)
2. balance of supply and demand (in terms of skilled medical manpower)
3. emphasis on efficiency: (for the system as a whole)
    health maintenance
    cost consciousness
4. building on the strength of existing systems.

Given these considerations, NASA undertook a study to determine the manner in which applications of its technological and managerial skills could address the problem. It soon became obvious to NASA scientists and engineers that the natural choice would be the "provision of access to health care for those people located in areas where health care is not available." The rationale for the focus on access problems was based on the following considerations: (a.) the unique capabilities of NASA in terms of its experience in providing care to persons in space flights; (b.) the fact that such a problem is amenable to systems analysis, an expertise well developed at NASA; and (c.) all technologies that are required for its successful implemetation —system management and engineering telecommunications, and information processing — were ones in which NASA excels. Thus, NASA chose to do for earthbound applications what it had learned to do best from its space program. However, it also intended to use this opportunity to gain practical experience from test projects to be conducted on earth. It sought to verify the conceptual designs developed to provide health care to space stations.

NASA's scientists assumed that a concerted national effort to increase the supply of physicians and to achieve a more equitable distribution of resources would require a minimum of 20 years to reach a balance between supply and demand. Their basic premise was that the supply approach, i.e., producing more physicians and placing them in underserved areas, would be of no immediate value to the American people since it would leave many segments of society without adequate medical care for a long time. In addition, the quality of health care was recognized as not uniform, some people receiving high quality care and others not.

NASA's study stressed that the following conditions had to be met if the problem of access to care was to be solved: (a.) patients must be provided accessible points of entry into the health system, i.e., facliities near their homeplace; (b.) as the patients enter the system, they should be sorted and routed according to their medical need, i.e., some of them will be cared for at the entry point by non-M.D. providers and others with more serious medical need may be referred to specialists, either physically or through teleconsultations; (c.) the expertise of non-M.D. providers has to be extended to care for routine problems in such a way that does not jeopardize the well being of the patient; (d.) to be cost-effective, and to make the most efficient use of the physician's high level of training and skills, some of the functions normally performed by the physician have to be delegated to non-M.D. providers; (e.) medical emergencies should be disposed of adequately under all conditions; (f.) and finally, the patient's confidence in the system must be assured, i.e., rapport between the physician and the patient should be maintained at all times.

While developing its plan to meet the conditions stated above, NASA adopted certain guidelines that were eventually reflected in the design of its study. The guidelines stipulated maximum use of existing capabilities, an emphasis on flexibility, expandability, and adaptability, as well as the employment of the concept of Health Maintenance Organizations (HMOs). Because of its primary space mission, NASA perceived its proper role to be limited to the design, initiation, and some aspects of evaluation on the assumption that, in the long run, DHEW would take over any or all aspects proven efficacious in its designs for wider implementation.

These guidelines, in addition to the conditions to be met, were translated into the following operational objectives for its plan: To extent possible the plan would use:

1. existing medical establishments in a variety of functions, to assure their support and participation;
2. non-M.D. providers in clinic capabilities under supervision of physicians;
3. communications technology to provide various forms of consultations, supervision of non-M.D. providers, direct attention of physician, and to establish rapport between physician and patient;
4. appropriate combinations of fixed and mobile satellite clinics to meet varying community needs; and
5. information processing and automation technology.

At this point, IMBLMS technology and concepts were addressed to applications of health care delivery. This was the Area Health Service Field Unit (AHSFU). Its basic configuration comprised a full service comprehensive telemedicine system with the flexibility to stand alone or become part of a larger network. The AHSFU concept had four essential components: the Local Health Service Center (LHSC) corresponding to a fixed-site satellite clinic; the Mobile Health Service Facility (MHSF) corresponding to a satellite mobile clinic; Health Services Transport Equipment (HSTE) including a roving dispensary ambulance, a regular ambulance and portable health services equipment; and finally, the system was coordinated and controlled by the Health Services Support Control Center (SCC). It was conceived that one AHSFU could serve any given size community, whether or not a medical center or a hospital was available in its area. Typically, the referral center was outside the AHSFU configuration, thereby enabling several AHSFU's to utilize the same referral center—such as in a regional program.

Briefly, the AHSFU concept constitutes a multi-site delivery system with support facilities to handle emergency problems and a centralized referral center. Patient entry to the AHSFU can be made at one of two points: the satellite LHSC or the mobile clinic MHSF, both staffed by non-M.D. providers. These entry points can vary in size and mobility, but all are equipped to provide primary and follow-up care, to make referrals, and to arrange for transportation, if needed. Their staff will acquire medical histories, conduct physical examinations and health screening examinations, as well as provide preventive services.

NASA suggested joining with DHEW in a program definition study to identify a suitable location for a demonstration and test site, since DHEW would decide what, if any, parts of the proposed design would be appropriate for implementation in other areas. The AHSFU concept had built-in flexibility in order that it could be used in a variety of settings with different manpower and technical configurations. Thus, if seen fit, the whole nation could be linked by a national network.

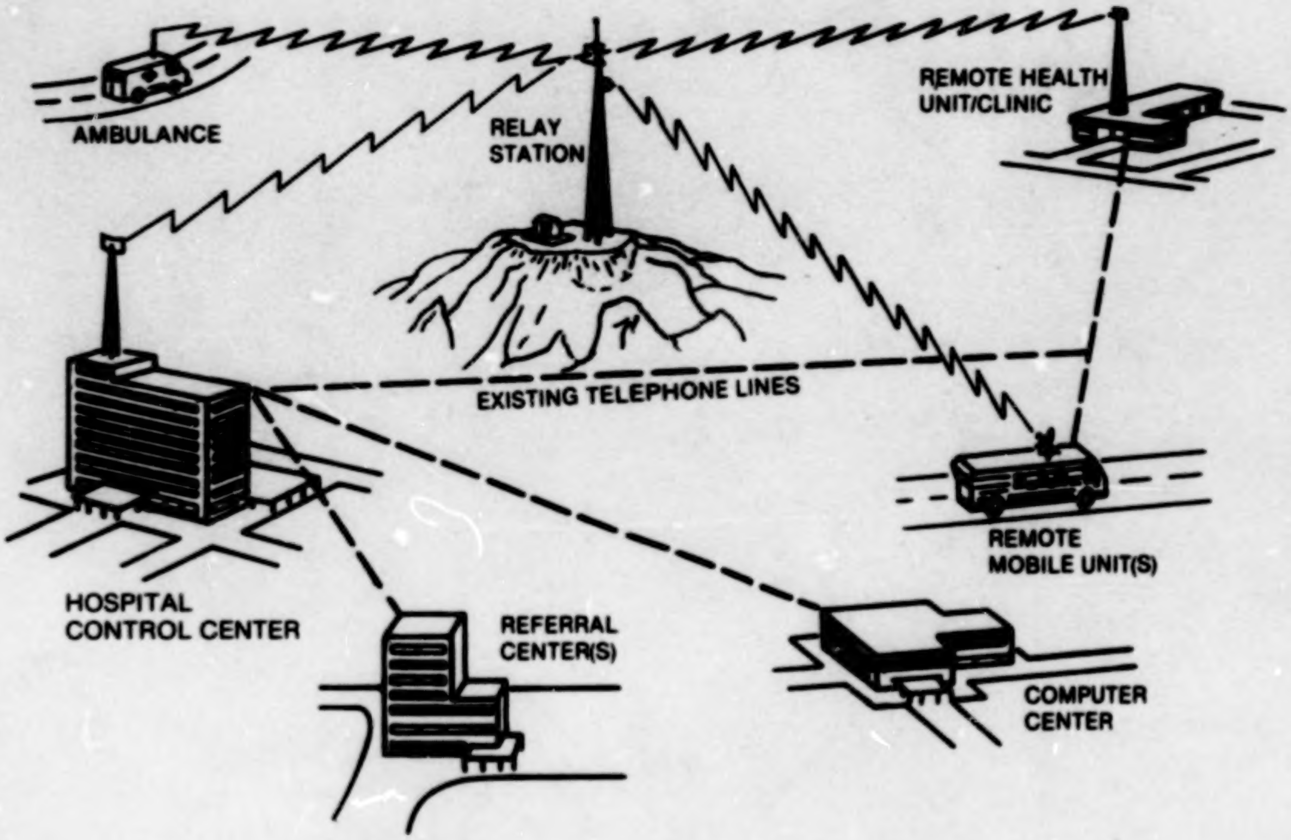

AMBULANCE
RELAY STATION
REMOTE HEALTH UNIT/CLINIC
EXISTING TELEPHONE LINES
HOSPITAL CONTROL CENTER
REMOTE MOBILE UNIT(S)
REFERRAL CENTER(S)
COMPUTER CENTER

Figure 6: Typical AHSFU System Configuration

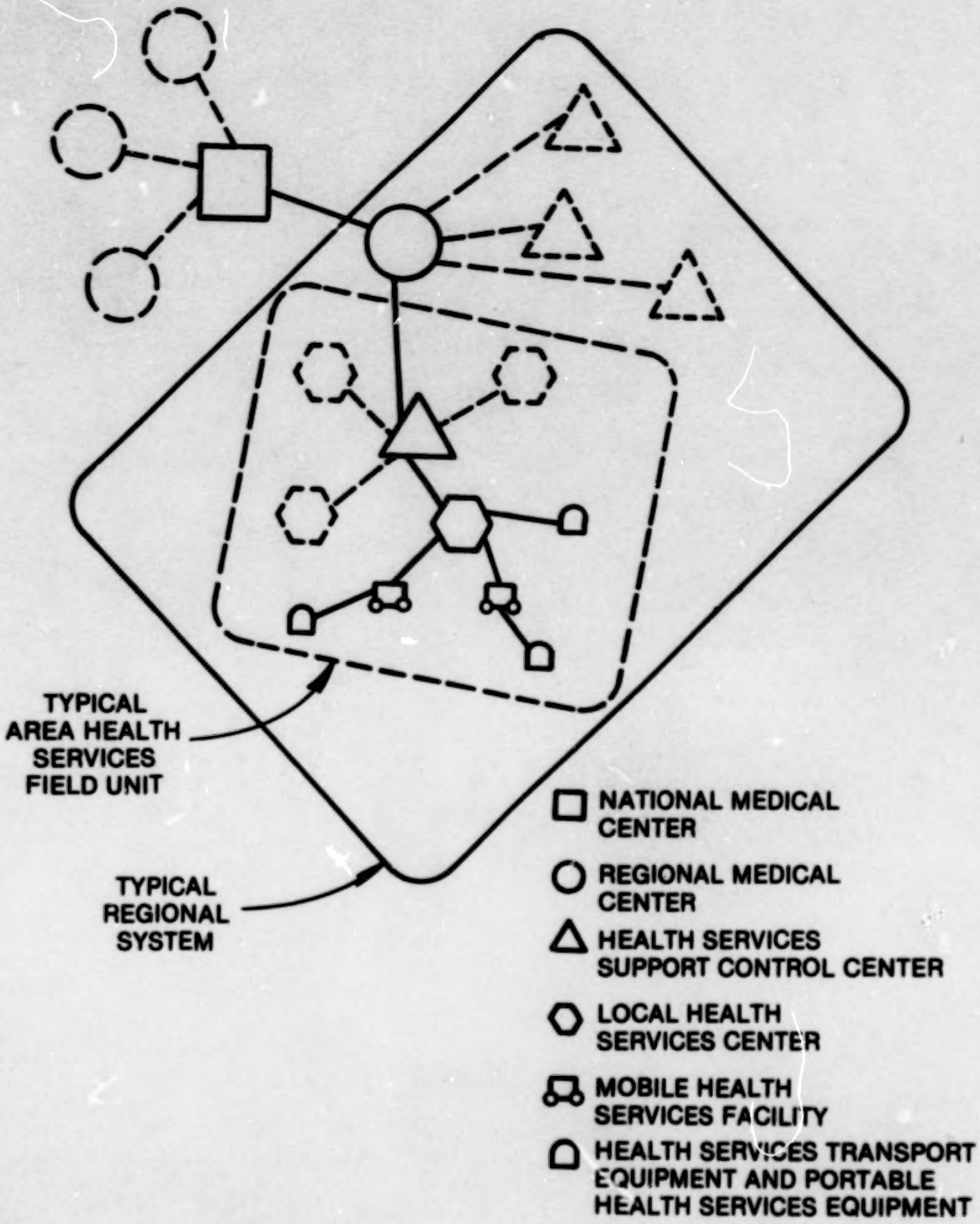

TYPICAL AREA HEALTH SERVICES FIELD UNIT
TYPICAL REGIONAL SYSTEM
NATIONAL MEDICAL CENTER
REGIONAL MEDICAL CENTER
HEALTH SERVICES SUPPORT CONTROL CENTER
LOCAL HEALTH SERVICES CENTER
MOBILE HEALTH SERVICES FACILITY
HEALTH SERVICES TRANSPORT EQUIPMENT AND PORTABLE HEALTH SERVICES EQUIPMENT

Figure 7: National Telemedicine Network System Configuration

As might be expected, NASA's sophistication in communications and systems design is vividly revealed in its plan. It provided detailed plans of its communications system requirements to the President's Domestic Council, at the same time falling short on the organizational requirements of its proposed system. The specific definition of the role to be performed by each level in the system, the clinical appropriateness and limitation of each component in the system, and the nature of the organizational structure that was necessary to make the system work were not emphasized in its study. There was in the study the implicit assumption that, if the communications requirements were adequately designed and implemented, the system would function effectively. However, it should be pointed out that NASA attended to the organizational requirements in its subsequent plans when the request for proposal was issued in January of 1972, inviting private industry to design and conduct a test project. Moreover, a rather prominent role was envisaged for DHEW to ensure the continuance of the project beyond the test stage and the distribution of this concept to other parts of the country where it may be deemed desirable or necessary.

Yet, despite the emphasis on the universality of the AHSFU concept—embodied in its design to have flexibility, expandability, and adaptability—and the view toward a national network of AHSFU's, NASA focused its design to rural areas suffering from lack of access to quality care. It can be appreciated that NASA was searching for a strong rationale to demostrate the immediate utility of its concept, and that was convincingly achieved by designing a system to help rural area residents without adequate medical care. Less attention was paid to the potential ubiquity of the technology and the design of systems to help not only the urban poor but also the entire medical care system. Presumably, these areas could be more fully investigated after successful demonstration in a rural area. These issues will be discussed in the last chapter.

The Involvement of Private Industry

As part of its follow-up to the President's Domestic Council's request, and in order to apply the IMBLMS technology, NASA's management decided to go ahead with the next logical step, namely, the selection of a contractor to design, develop and operationally verify an AHSFU test unit. The end product was defined as an AHSFU test unit that would be designed, assembled and operationally tested, taking into account the operational guidelines contained in NASA's recommendations to the President's Domestic Council. But the actual selection of the specific test site was regarded as the government's responsibility, and a joint NASA-DHEW site selection board was developed, as is described below.

Three companies responded to the RFP issued in January of 1972—LMSC, GE and IBM LMSC and GE with IBM as a sub-contractor had been NASA contractors on IMBLMS. All proposals were reviewed by NASA's Source Evaluation Board which stressed four criteria for its choice of contractor:

1. Mission suitability, translated into three specific requirements ranked in descending importance:
   - — understanding of requirements (the basic concept, technical requirements, etc.)
   - — key personnel (individual qualifications)
   - — corporate or company qualifications (track record)
2. Cost factors
3. Other factors (e.g., safety, reliability, quality assurance)

The choice of LMSC was not surprising, especially in view of their earlier work on IMBLMS, as previously mentioned. However, the budget was small by LMSC standards; presumably their interest was in the potential for a larger market for these systems. The basis of the contract was "cost plus fixed fee"—the fee was set at $312,497 and the total budget was originally $4,942,079. The budget was substantially reduced during the site selection phase of the project as a result of a NASA budget realignment.

Request for Proposal (RFP). There are several details in the procurement process that attract attention, particularly the RFP that was issued by NASA to prospective contractors. While conforming to standard government procurement regulations, it is a classic statement — though perhaps one commonplace to NASA — of a comprehensive systems approach, including a precise statement of objectives, procedural requirements, systems requirements, design specifications, program management, and expected end results for each of these components. The RFP specified that NASA wanted to develop a remote health services capability for its future long-duration space flights, and that this would include emergency, primary and preventive services. As well, the specific role of telecommunications was expected to provide control of the system, minimize the need for travel and to educate the participants in the system. Computer management techniques were to be developed for the computer-based data system, including both hardware and software, in order to implement a computerized uniform medical records system.

The RFP expected the applicant organization to follow NASA's design concept in planning a system in which specially trained non-M.D. providers and advanced communications, data management, and medical instrumentation techniques would be integrated to provide health services to a population with demonstrable access needs. One test of the efficiency of the system would be the ability of the physician to effectively supervise the work of several non-M.D. providers.

The demands on the contractor included a special task of conducting an analysis of the leading candidate test sites. In addition, the contractor was expected to produce specific plans for the design of the entire project, acceptance testing, training and operational readiness certification.

The technical requirements that had to be addressed by the prospective contractors were detailed under eight major components:

1. Program definition and system design
2. System assembly, testing and operations
3. Cost effectiveness
4. Organization requirements
5. Support requirements
6. Safety
7. Reliability
8. Quality assurance

The first two components were discussed in great detail, including a statement of objectives, identification of system requirements, design specifications, actual design, specific plans and costs and end results.

The basic objective of the requirement for (1.) program definition and system design, was to provide a complete definition of an AHSFU project and its costs. Such definition had to include complete plans, designs and cost. In addition, the contractor was expected to conduct an analysis of the leading candidate test sites for the AHSFU project and provide results of their trade-off studies. It was further stipulated that the contractor "shall utilize for the operational site exclusively, the information described in 'A Remote Health Services, Research, Demonstration and Evaluation Project,' which the State of New Mexico Health and Social Services Department completed under contract HSM-110-69-243 with DHEW. NASA was involved in this study to a minor degree. However, NASA also indicated that its own criteria were to supersede in case of conflicts between its own requirements and those of the New Mexico proposal.

The mention of the New Mexico report in NASA'S RFP was significant since the New Mexico site was later a serious contender to be the test site.

The end results expected for the Part 1, program definition and system design were as follows:

a. Program definition report.
b. Requirement specifications: functional, operational, design.
c. Site evaluation technical analysis report with recommendations and cost analysis.
d. Complete system design specifications.
e. Complete system design.
f. All necessary plans to complete the project.
g. Complete cost breakdown.
h. Final report, completely documenting all items above and a final presentation.

The objective of Part 2, system assembly, testing and operations, were focused on the production of the system itself, namely, to fabricate, assemble, and install at the test site an acceptance test system to operationally verify requirements. Part 3 included efforts to operate the system for a two year period and evaluate and analyze data for feedback into future flight program plans.

The evaluation plan that NASA had envisaged consisted of two distinct parts. The first pertained to the engineering testing and technical performance of the equipment, with emphasis on safety, reliability, and quality assurance. The second part dealt with the impact of the system on health care delivery, our primary concern here. The plan indicated that the effectiveness of AHSFU in actual operation in a community sould be analyzed in terms of its clinical performance, i.e., its success in diagnostic and therapeutic procedures, as well as its community impact—its ability to effect changes in utilization of services and the health status of the population served by the system by improving accessibility in remote areas. It was further stipulated that, "Information should be collected to assess the adequacy of scheduling of patient clinic visits and the adequacy of routing and use of mobile dispensaries."

Criteria for evaluation*, based on the performance of the specific components of the system (subsystem performance) were also given. These are presented in the chart on the following page.

---

*Medical care delivery evaluation is discussed in Chapter 5.

Criteria for Technical Evaluation

Subsystem	Reliability	& Availability	Replacement Rate	Accuracy (Quality)	Maintainability
Instruments	X		X	X	X
Signal Conditioners	X	X	X	X	X
Communications	X	X	X	X	
Displays	X	X	X	X	X
Computer Systems	X	X		X	X
Facilities Systems	X		X		X
Mobile Equipment	X	X			X

The end products of parts 1, 2 and 3 were identified as follows:

1. Completion of plans, software, specifications, drawings, and other documentation.
2. Assembly of AHSFU.
3. Acceptance testing of AHSFU.
4. Preparation and conduct of training and related activities.
5. Operations, training, and maintenance manuals.
6. Operational plans and procedures.
7. Installation and checkout of system at site.
8. Participation in and support of operation testing.
9. Evaluation and analysis of data and upgrading of plans, procedures, facilities, equipment, training, etc.
10. Upgrading program definition plans, designs, costs.

Perhaps the most reasonable interpretation of NASA's approach, at least in this instance, is that it develops and manages programs using systems management and systems engineering approaches engaging private contractors to develop and to build systems to its direction and specifications as appropriate.

The role of the contractor was defined in considerable detail by NASA. In response to NASA's RFP, the contractor had to assure complete understanding of its specifications. Indeed, NASA used this as a criterion for selection, namely, that the contractor had to demonstrate full understanding of its concept and the specific requirements for its implementation. The NASA administrator was satisfied that LMSC met not only that requirement but also had a demonstrated capability to complete the task, particularly in terms of its program management. Neither GE nor IBM were selected for additional work on this project.

The Site Selection Process

While it may be appreciated that local communities might perceive economic or service benefits to their locality from the coming of a large project like STARPAHC, and therefore would try to present themselves in a favorable image to attract the project, this is not our concern here. Of interest, however, are the various scientific and operational ramifications that impinge on choice of site. First, there is a basic issue of the nature of the sampling and/or representation of the community. The more a specific site deviates from a "typical" community — i.e., the more unrepresentative it is — the less generalization can be made from it to other, presumably dissimilar, communities. This assumes, of course, that the characteristics of the community are related to the particulars of the evaluation design, such that they affect the outcome of the study or analysis. On the other hand, operational requirements intended as safeguards to ensure the successful completion of the project would call for certain untypical community characteristics, in this case, remote, underserved, receptive, but with a rich data base. Added to this was NASA's dual set of objectives: the space program and ground-based health care delivery, together with a supplemental requirement that the project be continued beyond the expiration of the testing and demonstration period. That is to say, the question of *representation* was not crucial for NASA. A set of specific objectives pertaining to its space program were crucial, but none of them truly reflect any site-specific differences. As well, a specific set of objectives pertaining to ground-based delivery systems could well be served in any site in which there were appreciable distances between patients and providers. The supplemental requirements of community acceptance, of having a data base, and having a high probability of continuation tended to lead further to the selection of what many would consider an unrepresentative site.

Therefore, it can be seen that the operational objectives might have been well-served by the choice of the Papago Reservation. Moreover, those scientific objectives that are not site-specific could have been equally served by this or any other site. Nonetheless, the issue of representativeness in the sense of this discussion was not seriously addressed.

These events leading to the site selection constituted significant aspects of the history of STARPAHC, and the preparations that were made for the selection were quite extensive. Indeed, an elaborate selection process was undertaken involving work by private companies, LMSC and Boeing, and two federal agencies, NASA and DHEW. Both LMSC and Boeing were involved in separate agreements to gather data and develop methods to assist in reviews of potential sites. LMSC was involved in site selection analysis, while Boeing's preliminary investigations were completed prior to site selection activities. The involvement of DHEW was intended to launch the development of a joint effort in which each agency could contribute substantially on the basis of its expertise and mission. These various roles should become clearer as the rest of the story unfolds.

The Selection Board. The site selection activities were performed by two different groups. The contractor of NASA (LMSC) presented detailed analyses of data and possible methods to apply to the selection process. The decision-making body was a joint NASA/DHEW site selection board. This board was supported by a joint working committee for site selection.

The first step was the convening of a committee to establish the necessary site criteria. To this end, a joint DHEW/NASA IMBLMS Site Selection Board (SSB) was chosen in June, 1972. The SSB membership included the following: from DHEW, - the Administrator of the Health Services and Mental Health Administration (HSMHA Chairman), Associate Deputy Administrator for Development, HSMHA, and from NASA - Headquarters, Director of Life Sciences and the Director of Life Sciences, Johnson Space Center.

The choice of other DHEW officials emphasizes a definite role for DHEW in research and evaluation, as well as the continuation of the project beyond the demonstration stage. Indeed, these were plans contemplated by NASA at that time.

A site selection work committee was appointed to facilitate the work of the Site Selection Board in reaching a final decision on the site. The composition of this committee was equally divided between NASA and DHEW personnel knowledgeable in the telemedicine area. The committee developed an outline and narrative description of the IMBLMS/AHSFU site selection criteria in September of 1972, and a press release was issued in November of the same year. It stated that the Site Selection Board would evaluate community applications received by December 4, 1972, and that a final decision would be forthcoming during February of 1973. The actual development of medical and systems evaluation criteria and weighting factors was to be completed during a five and one-half week period beginning the week of November 13, 1972. The negotiations of the AHSFU contract for the selected site were to be conducted during May and June of 1973.

As described in the initial working statement of the site selection work committee, the primary consideration was to be given to system constraints, the cost of the system at the selected site as compared to other possible locations, the interrelationships of the social and behavioral characteristics of the community with the system, and the capacity of the community to provide the needed medical support.

System Constraints. It was suggested that the site be located in an area of moderate environmental conditions, i.e., with no extremes of temperature, humidity, and topography that might interfere with the IMBLMS/AHSFU system operation—particularly signal transmission. Adequate roads were necessary to accommodate heavy mobile health units and to minimize the need for special transportation vehicles. Road constraints and adequate utilities were stressed also to avoid the necessity of "major ruggedizing of equipment."

Characteristics of the Community. The initial consideration of suitable community characteristics included a guarantee of acceptance of the AHSFU project by local professional health providers and consumers. Particularly important was the definition of the legal status of non-M.D. providers to staff the satellite clinics under the supervision of physically distant physicians in the applicant area. The community was also to provide a pool of labor from which those trained as medical and technical personnel would be able to operate the system after initial training. In order to obtain adequate data on all fields of medicine necessary to evaluate the remote system, the community had to have no less than 10,000 persons. The community also had to manifest a need for augmented health services and a population adequate to provide mobile clinics with a minimum of 20 patients per day and a local health services center (or satellite clinic) with a minimum of 40 patients per day. Finally, the community was to possess no "geopolitical problems," and the AHSFU project was to be compatible with any program of local or regional comprehensive health planning agency or other existing health planning bodies. This project was not intended to alter the medical *status quo* in the community.

Medical Considerations. In addition to the characteristics of the community, it was further indicated that there had to be a hospital with a full range of services and a 24-hour emergency operation to serve as a referral center; that medical personnel would be available for rotation between the medical center and the outlying units; and that a data base was available utilizing uniform medical records and also providing for confidentiality of information.

The Boeing Study. As mentioned earlier, a special contract was awarded by NASA to Boeing for the purpose of conducting an exhaustive analysis of candidate sites covering the whole country. Boeing completed its final report in three volumes prior to formal initiation of the site selection activities. In that report, Boeing reviewed data published by the AMA in 1970 concerning the physician distribution in the United States, and on the basis of the criteria (detailed below) found no outstanding candidate sites. However, the Papago Reservation received honorable mention as a potential candidate site.

The Boeing report did not prove to obviate the function of the site selection work committee because its analysis did not produce a sure winner. However, there were significant considerations that were made explicit, and the following is a very brief review of some highlights of this report. The important aspect of this report was the presentation of a detailed and explicit procedure for site selection, complete with criteria, weighting procedures, decision factors and a wealth of detailed data about candidate sites.

In this report there were five groups of factors:

1. *Geographic Factors* relating primarily to the suitability for IMBLMS operation with minimal disruption.
2. Desired *Population Characteristics* are described that would assure participation and provide for an adequate patient load and spectrum to assure adequate system evaluation data.
3. Criteria relating to *Existing Health Facilities* include the desired distribution or fixed-feature space of medical opportunities and facilities suitable for IMBLMS. It seems that *acceptance* criteria here are based upon arbitrary distance values believed to encourage participation or reflect adequate availability.
4. A fourth set of factors, *Area Facility Thoughts*, lists desired industrial and agricultural percentages, the required utilities, and the desired educational and recreational facilities.
5. A final set of criteria is comprised of *Social Features* which include selected sociodemographic characteristics such as family size, languages spoken, mores and folkways, type of society, and "tribal" or community attitude* toward IMBLMS.

A screening of counties with populations of over 5000 was conducted based upon medical care need criteria, namely, medically underserved areas. An initial screen determined that there were only 14 counties distributed over 7 states without a resident physician. Of these 14 original counties, 9 were eliminated by applying a criterion of being within 150 miles of a state supported medical school (with 24-hour emergency capability). Only one county (Clark County, South Dakota) survived through a third screening. It was acceptable only on the basis of measure of nearness to any health service or nearby medical facility. Based upon these screening criteria, it was concluded that there was not a single county of outstanding medical care need and that medical services were available within 50 miles or less to all counties of over 5000 population, similar to the conclusion earlier arrived at in the AMA report.

Also included in this Boeing report to NASA were site analyses of four potential Indian sites including Alaska, the Navajo Reservation Area, the Pueblo Indians in New Mexico, and finally, the Papago Reservation in Arizona. These reservations were included at the suggestion of NASA; data about them were not included in the AMA report.

The Alaska and New Mexico site analyses concluded that there were too many problems—particularly related to environment—to enable a satisfactory IMBLMS evaluation. The Navajo Reservation Area, however, was initially labeled a good opportunity. It was subsequently discarded, however, due primarily to the discontiguities of the Indian population there and the low population density. In a comparison of potential Indian sites, the Papago Reservation was concluded to be the most suitable Indian site for the AHFSU project. This was subsequently verified in competition with cost configurations of eight similar systems from other parts of the country (non-Indian sites).

---

* The acceptance criterion for community norms was characterized as desirous of Western medical care."

The simple summary statement of the report is particularly significant:

"The similar systems identified do not afford IMBLMS the overall test site capability of the Papago Reservation.

- HEW/NASA acceptance of solution.
- Must resolve socioeconomic and legal aspects of IMBLMS operation.
- Coordination of local and state governments.
- Resolve working agreements."

This material was used by the site selection work committee (joint DHEW & NASA). However, the work committee added significantly to the data and criteria in discharging their responsibilities to the Site Selection Board. There will be a separate discussion of the special qualifications of the Papago Reservation in the next chapter.

Summary and Conclusions

It has been seen that the concept of telemedicine has some of its roots in NASA's space program, and some of its basic technology had been developed by NASA's engineers and scientists. It has also been seen how NASA's early concern with the ill effects of zero gravity dissipated with safe experience, and how it was replaced with a more serious concern with the development of comprehensive systems for health care delivery for future spacecraft and interplanetary travel as embodied in IMBLMS. While the Congress did not provide funding for the Space Station Program, the President's Domestic Council requested federal agencies to provide specific recommendation for solutions to the nation's most pressing problems. NASA's response addressed housing and medical care problems, and for the latter focused on accessibility, namely, the shortage of medical manpower in remote areas.

In its report to the Domestic Council, NASA designed a modular health care network that relied heavily on systems management, telecommunications, telemetry and computers, and utilized non-M.D. providers. The basic unit in the network was the Area Health Service Field Unit (AHSFU) — a complete telemedicine system configuration. This unit was designed to provide expandability and flexibility in size and configuration, as well as universality in coverage. That is, the unit (a module) could be applied in one community as a single system or be linked to other systems into a larger network. These networks would be extended to cover a region in the United States, and the regions in turn could be linked to form a national network. NASA conceived of its role as a partner with DHEW, but only in the design and initiations of these systems, and it assumed that it was DHEW's role to operate these systems and to evaluate their medical efficacy and impact on health care delivery.

NASA kept its sight on its primary space mission, but sought to develop a demonstration test project that could serve two sets of purposes, one related to its space program and the other to earthbound applications, hence the STARPAHC project.

A site selection board was launched representing DHEW and NASA. After the Papago Reservation was designated as the site, AHSFU was changed to STARPAHC, reflecting an emphasis on the positive role of the Papago advanced health care system.

The site selection process, though raising questions about the appropriateness of a unique community setting for generalization purposes, tends to illustrate incompatibility of some of the goals as perceived by NASA and DHEW. Once the socio-legal logistics — including community acceptance and the legality of clinical work by non-M.D. providers — were met, NASA's objectives in operational testing and evaluation and development of protocols and role configurations could be accomplished irrespective of the setting. However, the applicability of the experiment to other areas is the primary concern of DHEW, and the choice of site may determine the generalizability of the findings to be derived from the experiment. Indeed, NASA's interests could be best served by the choice of a unique sparsely populated environment in which access to medical service is a serious problem, the closest analogy to conditions in outer space. But if this problem is unique to the Papago Reservation, then the solutions proven efficacious there may not be applicable elsewhere.

In the following chapter, the role of the Indian Health Service in general and its specific contributions to STARPAHC will be discussed.

BLANK PAGE

BLANK PAGE

Chapter Three
THE INDIAN HEALTH SERVICE

Introduction

Serving as a vital link between NASA and the Papago Tribe was the Office of Research and Development (ORD) of the Indian Health Service (IHS). The staff of the ORD were not only instrumental in securing the STARPAHC project for the reservation, but they also played a crucial role in the design and implementation of the project. In addition, they assumed a strong advocacy role with regards to the Papago interests in the design process. It is clear that without the involvement of ORD, STARPAHC may not have come to the Papago, and without ORD participation, much of the project configuration and policies would not have been the same. The Papago proposal to the Site Selection Board was prepared by the ORD at the direction of the Papago Executive Health Staff and submitted as a joint effort of ORD and the Papago. Having cooperated on a variety of other programs, the two groups have general respect for each other and were familiar in handling issues and projects involving Papago community needs. It is quite apparent that an excellent working relationship was established between the ORD and the Papago on the basis of mutual respect, shared responsibility, and division of labor evidenced throughout this project. This relationship proved most valuable in facilitating the introduction of STARPAHC into reservation life and its effective acceptance by the people.

The development of the working relationship between the Papago and ORD will be traced here through the evolution of the Indian Health Service and the activities of ORD. A history of the Indian Health Service of course, would be incomplete without a brief look at the general condition of American Indians.

The American Indian

Because of the unique position of American Indians in our society, their status is often misunderstood. While they are legally recognized as full-fledged citizens of the United States, with privileges, rights and responsibilities equal to all other citizens, they also have a "special" status. The federal government has maintained a unique trustee role toward these Native Americans on the basis of treaties that were concluded with various tribes and the reservation status of many Indians. Perhaps for reasons inherent in their sociological and ecological structure, being of diverse cultures and geographically scattered, they, for many years, were not able to assert themselves as a united front in their dealings with the federal government.

Although their numbers are not exactly known, it is estimated that there are less than one million Native Americans—those who declare themselves Indians and are similarly accepted by peers. About half of this number live on reservations in various parts of the country and the other half are scattered without recognizable concentrations. Culturally, Indians have typically identified themselves as member of tribes or nations, quite distinct from each other, having different belief systems and leading different styles of life. But, irrespective of cultural diversity, they have consistently shared a reverent view of the natural environment and sought to live in harmony with nature. Belatedly, this view was adopted by ecologically conscious groups after it was recognized that we may have gone too far in devastating the environment in which we have to live.

The areas many Indians call their home usually constitute only a portion of their ancestral land. Thus, the wide expanses of land that used to contain wild game and provide for other sources of food have been severely reduced, much of the wild game disappearing. The critical problem here is that the style of life that was sustained in the ancestral land is no longer possible in the confines of the reservation. Many Indian homes lack refrigeration and reservations often lack efficient transportation. Therefore, the food available in many of the general stores on many reservations consist largely of non-perishable starch products. Sanitation and housing are often sub-standard. Some of the most crucial health problems are, therefore, more amenable to educational and environmental health programs than to an increase in the use of personal health services. Indeed, what continues to be needed is a general upgrading of the standard of living and provision of some of the modern amenities such as efficient communications and transportation systems, adequate housing and nutrition and, perhaps most important, viable and productive economic systems.

Historically abused and neglected by the federal and state governments, the difficulty of solving these complex problems is compounded by the fact that Indians have not yet achieved a coalesced political power base because of their geographic dispersion, their limited numbers, and their cultural variations. Lacking in political clout and organization, Indians retain the uneviable position of an often overlooked minority.

The history of federal Indian policy is replete with inconsistency, ranging from genocide and incarceration to overprotective paternalism to forced termination of reservation life. For example, while in the thirties a trend toward supporting tribal cultures and traditions started, predominant federal policy during the 40's and early 50's called for the integration of American Indians into "mainstream American life" as a way of reaching a permanent solution to all their problems. In principle, it was assumed that the best solution for the problems of a unique minority in American society was to change its minority status, to blend it into the rest of society. This was to be achieved by de-emphasizing reservation status and consequently Indian identity, resettling Indians in urban areas so that they became indistinguishable as a group and, it was hoped, achieve full integration into American life with all its privileges. In as much as the Bureau of Indian Affairs (BIA) was responsible for implementing federal policy at the time, it tended to reflect this philosophy in its activities and programs. However, this policy was resisted by many Indian groups who wanted to maintain their cultural identity and saw the reservation status as the only environment in which this could be perpetuated. They tenaciously held onto their traditions and thus opposed many of the BIA activities directed toward their elimination.

Significant problems arose with the attempted homogenization of Indians into urban life. Many of the Indians who went to the cities looking for employment opportunities and improvement in life were dismayed with discrimination, urban squalor, and crowded living conditions, and soon returned to the reservation only to reencounter the problems of poverty that drove them away in the first place. Housing and employment proved difficult to obtain in the cities, and yet many Indians had to repeat the cycle of migration more than once—moving to the city, getting nostalgic for the reservation, returning to find only more disappointment, and back to the city to face problems of housing and employment.

Perhaps as a result of recognizing its failure, the federal government began to change its Indian policy during the 50's, and it was during this period that the IHS was organized. Thus, the IHS assumed responsibility for the health of the Indian people after a history of disappointments on the part of Indians in dealing with federal agencies. It should be added here that several national organizations including the American Medical Association and the State Health Officers Association lobbied in favor of moving health out of the jurisdiction of the BIA. They emphasized that health matters would not receive proper attention at the BIA because they had to complete all the other programs such as roads, housing and education.

A policy of self-determination for Indians was declared by the President's 1970 Message to the Congress, but it was not enacted into law until 1976 as the Indian Self-Determination Act of 1976.

The new policy acquired sanction and vitality with the enactment of this act and with the Health Care Improvement Act of 1976. Provisions were made in the latter to (a.) increase Indian professional health manpower; (b.) eliminate the backlog of unmet health service needs; (c.) construct and renovate health service and sanitary facilities; (d.) provide Medicaid & Medicare reimbursement for the Indian Health Service; (e.) increase accessibility to medical care facilities for Indians in urban areas; and (f.) provide for a study to determine the extent of need and feasibility of establishing a school of medicine to train Indians.

The Indian Health Service

It is fair to assert that prior to the organization of the IHS, there was no comprehensive health policy for Indians, and whatever health programs were available to them were geared to deal with categorical problems. Moreover, governmental programs typically ignored the cultural identity of Indians and the variations between the tribes. Thus, Indian health service remained largely fragmented and inadequate, without a serious concern of integration into Indian culture. Nonetheless, even prior to the establishment of IHS, historically there had been some notable efforts by the federal government to address some of these problems in a comprehensive fashion through various commissions that looked into the situation and made policy recommendations. One example of a positive policy was the passage of the Synder Act in 1921 which provided for health services for all Indians. As it turned out, the Act was interpreted within constraints of limited budgeting, and it was never totally implemented to cover all Indians, regardless of residence in or out of reservations.

The Indian Health Service was established on July 1, 1955, when the U.S. Public Health Service of the Department of Health, Education and Welfare acquired from the Bureau of Indian Affairs (BIA) of the Department of the Interior the responsibility for meeting the health needs of American Indians and Alaskan Natives. Even though relinquishing the responsibility for health matters, the BIA retained much of the responsibility for other aspects of Indian policy at the national level. The role of the BIA had traditionally been viewed by many Indian groups with some apprehension, and the BIA was sometimes referred to in uncomplimentary terms. For example, BIA was suggested to be an acronym for "Bossing Indians Around"; other, less flattering reference also existed. A major source of dissatisfaction with the BIA was the lack of genuine Indian involvement in its policy decisions.

From its inception, IHS embarked on an ambitious mission to rectify and alleviate the health problems of American Indians and Alaskan Natives who had not only been underserved but who had also been imposed upon with treatment modalities that were alien to their culture. The responsibility of the IHS was to plan and implement a total health program for these people. To accomplish its objectives, IHS activated a broad range of programs as a direct provider of care, which was an action unparalleled in the Public Health Service. Those programs included the operation of hospitals, health centers, itinerant clinics, as well as purchasing health services from various providers for its clients. In addition, IHS developed environmental health as well as nutrition and health education programs. Significantly, IHS has sought carefully to develop a meaningful rapport with Indian groups by actively involving them in sharing responsibility for the planning and implementation of health programs.

The initial priority of the IHS was placed on meeting the critical shortage in medical manpower and the serious deficiencies in health facilities. After ten years of modest

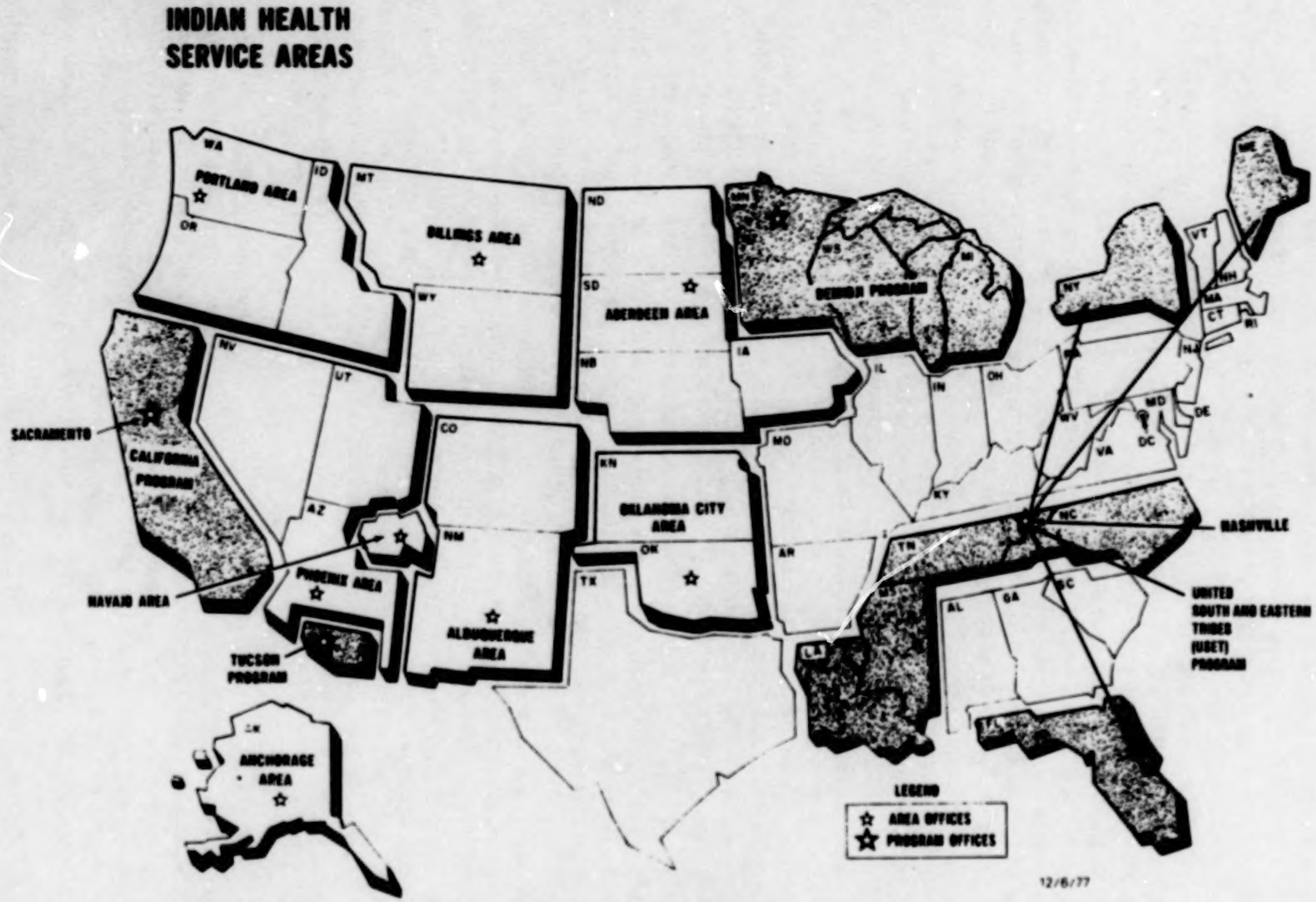

INDIAN HEALTH SERVICE AREAS
WA
PORTLAND AREA
OR
ID
MT
BILLINGS AREA
WY
ND
SD
ABERDEEN AREA
NB
MN
WS
BEMIDJI PROGRAM
MI
ME
VT
NH
MA
CT
RI
NY
PA
NJ
OH
IN
IL
IA
MD
DE
DC
WV
VA
KY
NC
NASHVILLE
TN
UNITED SOUTH AND EASTERN TRIBES (USET) PROGRAM
SC
GA
AL
MS
LA
FL
AR
MO
KN
OKLAHOMA CITY AREA
OK
TX
CO
NM
ALBUQUERQUE AREA
UT
AZ
NV
SACRAMENTO
CALIFORNIA PROGRAM
NAVAJO AREA
PHOENIX AREA
TUCSON PROGRAM
AK
ANCHORAGE AREA
LEGEND
AREA OFFICES
PROGRAM OFFICES
12/6/77

Figure 8: Indian Health Service Areas

improvement in these areas, it became increasingly apparent that the active participation of the Indian people in the development and operation of health programs was imperative, if IHS was to succeed in its mission. A map of current IHS Areas is shown in Figure 8.

In March 1971, an important statement was issued by the Secretary of DHEW that set forth the service mission of the Indian Health Service. After identifying the organizational affiliation of IHS as an integral part of the Health Services and Mental Health Administration (HSMHA)—now Health Services Administration (HSA)—its basic objective was defined. Specifically, the service mission of IHS was "to assure a comprehensive health services delivery system for American Indians and Alaskan Natives with sufficient options to provide for maximum tribal involvement in meeting their health needs. The goal for the Indian Health Service is to raise the health level of the Indian and Alaskan Native people to the highest possible level." The definition of the operational goals of the IHS were set forth as follows;

1. Assist Indian tribes in developing their capacity to man and manage their health programs through activities, including health and management training, technical assistance, and human resource development;

2. Facilitate and assist Indian Tribes in coordinating health planning, in obtaining and utilizing health resources available through federal, state and local programs, in operation of comprehensive health programs, and in health program evaluation;

3. Provide comprehensive health care services, including hospital and ambulatory medical care, preventive and rehabilitative services, and development of community sanitation facilities; and

4. Serve as the principal federal advocate for Indians in the health field to assure comprehensive health services for American Indians and Alaskan Natives.

The administrative structure of the IHS, consisting of five offices and four divisions, was identified. The specifics of each unit were established. In addition to the Office of the Director, there were the following offices, each of them charged with specific responsibilities and as a staff resource for the Service Director:

Tribal Affairs
Information
Program Management Services
Research and Development

The four divisions were: Program Formulation, Program Operations, Indian Community Development, and Resource Coordination. An IHS organization chart is shown in Figure 9.

The activities of the Indian Health Service have steadily increased over the years as has its budget, which grew from a total of $40 million in 1956 to $168 million for operational health programs and $44.5 million for construction of health facilities in 1973. However, the most significant factor has been the dramatic improvements in Indian health status which have been achieved. For example, maternal and infant mortality declined at a higher rate than that of the general U.S. population. Infant deaths dropped from a high of 62.5 per 1000 live births in 1955 to 22.4 in the same period. Maternal deaths among Indians decreased from 82.8 per 100,000 in 1958 to 33.9 in 1967. The death rates were reduced by 56 percent and deaths from gastroenteric diseases were 60 percent lower.

Other accomplishments of the IHS include the active involvement of Indian organizations in health matters. For example, in 1972 there were 30 intertribal health committees, 8 area Indian health boards, 200 reservation health committees, 200 community health committees and one National Indian Health Board.

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

PUBLIC HEALTH SERVICE

Health Services Administration

INDIAN HEALTH SERVICE

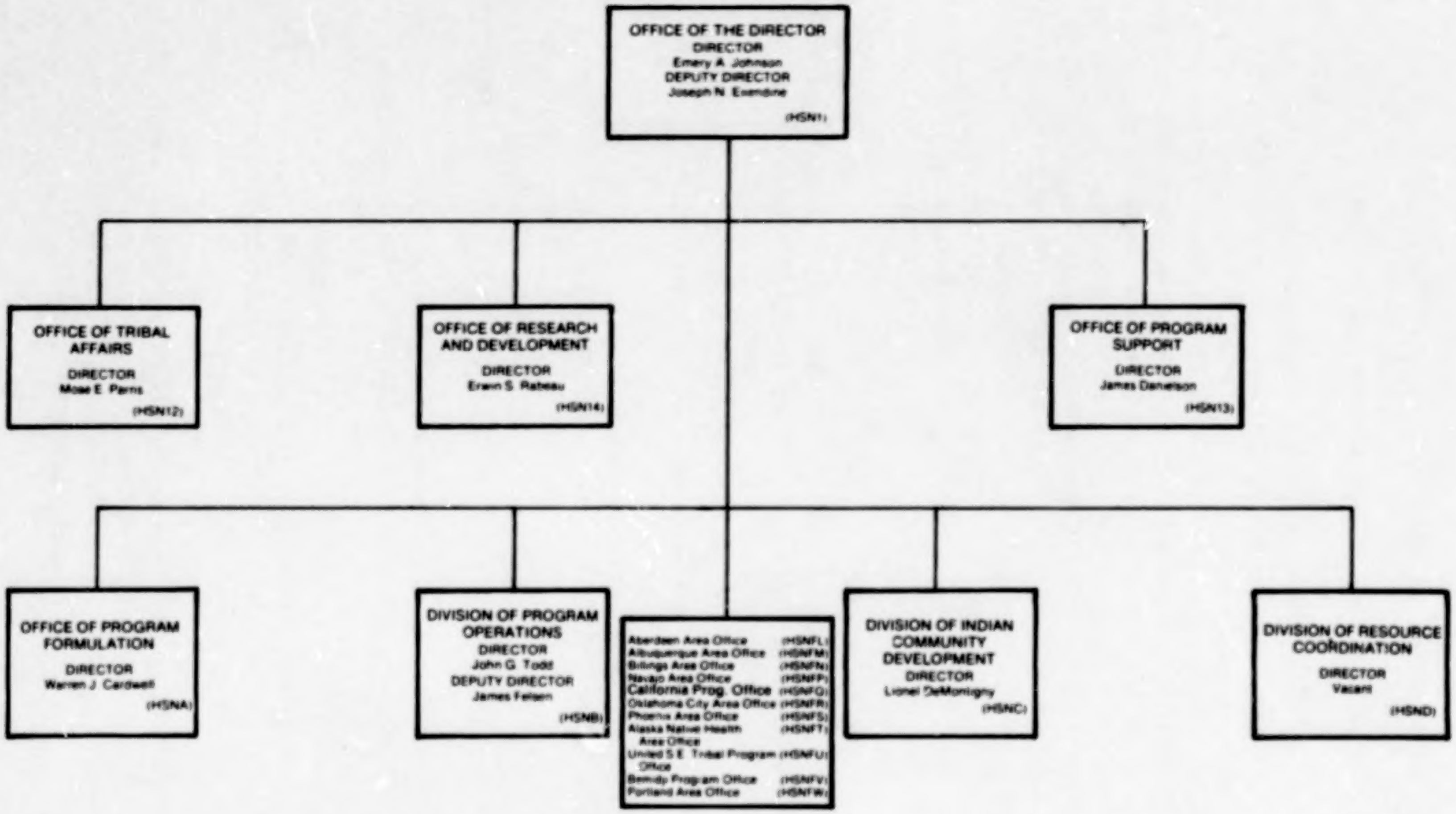

OFFICE OF THE DIRECTOR
DIRECTOR
Emery A. Johnson
DEPUTY DIRECTOR
Joseph N. Exendine
(HSN1)
OFFICE OF TRIBAL AFFAIRS
DIRECTOR
Mose E. Parris
(HSN12)
OFFICE OF RESEARCH AND DEVELOPMENT
DIRECTOR
Erwin S. Rabeau
(HSN14)
OFFICE OF PROGRAM SUPPORT
DIRECTOR
James Danielson
(HSN13)
OFFICE OF PROGRAM FORMULATION
DIRECTOR
Warren J. Cardwell
(HSNA)
DIVISION OF PROGRAM OPERATIONS
DIRECTOR
John G. Todd
DEPUTY DIRECTOR
James Felsen
(HSNB)
Aberdeen Area Office (HSNFL)
Albuquerque Area Office (HSNFM)
Billings Area Office (HSNFN)
Navajo Area Office (HSNFP)
California Prog. Office (HSNFQ)
Oklahoma City Area Office (HSNFR)
Phoenix Area Office (HSNFS)
Alaska Native Health Area Office (HSNFT)
United S.E. Tribal Program Office (HSNFU)
Bemidji Program Office (HSNFV)
Portland Area Office (HSNFW)
DIVISION OF INDIAN COMMUNITY DEVELOPMENT
DIRECTOR
Lionel DeMontigny
(HSNC)
DIVISION OF RESOURCE COORDINATION
DIRECTOR
Vacant
(HSND)

Figure 9: Indian Health Service Organization Chart

(In relation to the Papago, it will be seen later that the Office of Research and Development (ORD) of the IHS assisted in the establishment of an effective Executive Health Staff (EHS) on the Papago Reservation. It was largely through the efforts of the EHS that the STARPAHC project was ushered into the reservation with wide community acceptance and local support.)

However, despite these achievements, the IHS continued to be faced with formidable problems in meeting its charge of planning and implementing a total health program. The major challenge to IHS has risen because its responsibility is not confined to only the provision of medical services to the Indian people. Rather, its focus is on the factors impinging on the health status of the Native Americans. IHS must, therefore, deal with all factors that have a bearing on health. These include poverty and its attendant ramifications, poor housing, inadequate sanitation, environmental hazards, and malnutrition. Upon this difficult matrix where inevitable illness occurs, it has to overcome outstanding difficulties in access to medical care. In comparison to the majority of the general population, the Indian people face excessive difficulties to the receipt of care. Distances and communication constitute serious problems as do cultural heritage and jurisdictional disputes. For many Indians, the journey for medical care is still a dreaded all day excursion affair, including a long bus ride and a long wait at the clinic in an often strange, foreign, and sometimes hostile environment.

IHS has been delegated the primary responsibility for a variety of reasons. The Indians themselves, for example, have asserted that medical care is a treaty right, and is, therefore, the responsibility of the federal government alone. As a consequence, they have been reluctant to seek state or local program support. In addition, some state Medicaid programs have been reluctant to provide coverage to Indians since Medicaid is a residual resource program. At the same time IHS has adopted responsibility for Indian health care, it has been faced with severe limitations of funding and was often forced to restrict eligibility criteria to recognized reservation Indians.

The types of problems still to be resolved by the Indian Health Service include the following: (1.) A comprehensive approach to health, although a basic goal, has yet to be implemented. The Indian population still suffers from substandard housing, poor sanitation and inadequate nutrition. IHS funding thus far has not been adequate to support the type of program that is indicated in view of the multiplicity of these problems. (2.) Health manpower staffing is far from adequate, with few physicians and non-M.D. providers of Indian heritage. (3.) There is a high turnover in the medical staff at most service facilities of the IHS, and those who serve usually suffer from isolation and boredom. The problem has become more acute with the ending of the military draft. (4.) Much of the orientation to the Indian culture that is given to incoming medical personnel is provided by non-Indians. Moreover, some of the incoming providers tend to live much better than the people they come to serve, thereby increasing the social distance between them.

The Office of Research and Development

While the ORD is an integral part of the national organization of IHS and serves the needs of its administrative areas, it has a special relationship with the Papago Tribe. This relationship consists of two parts: First, ORD administers the health service facilities on the reservation, similar to an administrative area or service unit of the IHS. Second, the Papago Reservation has been utilized as a testing ground for most of ORD's innovative programs. Those that prove efficacious and cost-effective and recommended for application throughout IHS facilities. In addition, the offices of ORD are located on reservation land near the San Xavier Mission near Tucson in close geographic proximity to the main reservation.

Before ORD was established, the Indian Health Service created the Health Program System Center (HPSC) in 1967, originally named Operation SAM (Systems Analysis Module). HPSC was formally endorsed by the Papago Tribal Council on May 17, 1967, but it wasn't until 1971 that ORD came into being. The text of Resolution No. 14-68 of the Papago Tribal Council clearly explains the functions of HPSC. It reads:

WHEREAS: Operation SAM (Systems Analysis Module), an office of the new Health Program Systems Center of the Division of Indian Health, was activated at the Public Indian Health Center on the San Xavier Papago Reservation with an overall objective to develop, test and refine optimal ways of planning, budgeting and providing a comprehensive range of health services for our Indian and Alaskan Native populations, and

WHEREAS: On May 17, 1967 the Director of the Division of Indian Health announced the proposal to establish an independent area-like organization for the Sells Service Unit OPSAM operations and directed the Phoenix Area Director and Tribal Affairs Officer to carry this matter to the Papago Council to explain the proposal and to request the Council's acceptance, with the provision that the proposal be not put into effect until The Papago Council had indicated acceptance, and

WHEREAS: The proposed Health Programs Systems Center would be made up of two organizational units: The Sells Service Unit, which includes the Santa Rosa and San Xavier Health Centers as well as the Sells Hospital and OPSAM. The Director of the Center would be responsible for the total operation and accountable directly to the Division Director with the authority of an area director. The Center would have its own budget. It would develop its own plan to provide health services to the Papagos. The director would be responsible to see that the Service Unit had the additional necessary staff to assist in the OPSAM projects. In addition, the Phoenix Area Director is to be charged with the responsibility of seeing that the services provided to the Papagos were maintained at an acceptable level, to continue professional consultative services to the service unit staff, and to provide required administrative support, and

WHEREAS: The Division of Indian Health has submitted to the Papago Council for its consideration the proposal for inclusion of the Sells Service Unit as an integral part of the newly constituted Health Program Systems Center now headquartered on the San Xavier Papago Reservation, and

WHEREAS: The Papago Council recognizes this as an opportunity to participate meaningfully in the efforts to produce more effective and efficient health services for all Indians through a planned systematic program of change, and

WHEREAS: The Papago Council feels that this participation can be meaningful only if the Papago Council, the District Councils, and members of the Papago Tribe can play an active part in the furtherance of understanding and participation in matters of health and in the future development of the Health Program Systems Center programs.

THEREFORE, BE IT RESOLVED BY THE PAPAGO COUNCIL: That, the Papago Council hereby accepts and endorses the proposals of the Division of Indian Health to include the Sells Service Unit as an integral part of the Health Program Systems Center, provided, that

The Papagos participate in all future program development;

The Director of the Center keep the Papagos informed of all project developments through a Papago Affairs or Liaison staff representative;

The Director be responsible for including Papago representatives in the planning for health services for the Papagos, and

BE IT FURTHER RESOLVED: That, the Papago Health and Welfare Board be instructed to work closely with the newly constituted Health Program Systems Center;

The Papago Health and Welfare Board, or a sub-committee of the Board meet at least once a month with the Health Program Systems Center staff, or a committee to be appointed, for the purpose of working jointly with the Papago Committee to insure that the needs of the Papago people, as well as those of the Division of Indian Health, do in fact influence further health programs and do much to further understanding and participation in matters of health which are of grave concern to all."

As part of its reorganization, the Indian Health Service established the Office of Research and Development in 1971 for the dual purpose of increasing efficiency and Indian participation. The Health Program Systems Center (HPSC) was designated as a component of ORD, and it continues to function in that capacity. Thus, the basic mission of ORD was twofold: increase the efficiency and effectiveness of the service unit's performance and greater participation of Indians in managing their health affairs. To meet the first objective ORD utilized the techniques of systems analysis in its activities on the premise that this would improve the effectiveness and efficiency of health services in the Indian Health Service and would also lead to a better utilization of its resources. Subsequently, an all-inclusive system approach was adopted integrating the various social and rehabilitative services related to health. On this basis, the health system was conceived as comprised of a number of integrated subsystems. For these subsystems to function well, two requirements were stipulated:

a. Integration of available medical treatment and prevention services that are indicated to meet the health service needs identified by the recipient population.

b. Coordination of health services by the Indian people with all other community activities, including education, economic development, housing, nutrition, and communications, so that they can develop a concerted and balanced drive toward their objectives.

In serving the second objective, particular attention was given to the necessity of involving Indian people in its activities. To do this, ORD emphasized the development of Indian technical capability to enable them to assume greater responsibility. Therefore, the need for increasing the technical and managerial skills of the Indian people was recognized, and training programs were launched to meet those needs. Resources available from other federal agencies were utilized in this effort, including support from the Bureau of Health Manpower Education, National Institutes of Health, and the Office of Economic Opportunity.

The National Indian Training Center at Desert Willow was established in July of 1968. The site was located 13 miles from downtown Tucson and consisted of 143 acres. The facilities included well-equipped classrooms with provisions for food, lodging, and recreation. A wide range of courses are offered in the areas of Community Development, Management, Program Planning, Health Education, and other subjects in the field of Public Health.

Initially, and before training programs for Indians were developed, the Center was used for training Peace Corps volunteers in health-related programs such as TB control. Training of Indians and IHS employees commenced in 1970. More about the training program will be presented later in this chapter.

Coordination of the activities of ORD is carried out both informally among the appropriate units and formally through the ORD Intra-Mural Advisory Committee. This latter group includes representatives from the national headquarters of IHS and Area Directors and their representatives. Serving in an advisory capacity to IHS, this committee reviews the full range of research and development activities and facilitates their implementation in other areas of the country that are served by the IHS.

At the meeting of the committee in December of 1971, it was recognized that several projects initiated by HPSC had reached the point of being ready for wider implementation. The following projects were considered: Health Information System (HIS), The Tuberculosis Model, the Outpatient Simulator, the Manual Surveillance System and the Public Health Nurse Reporting System. It was agreed that some of them would be adopted as local policy such as the Manual Surveillance System, while others, notably the HIS would be recommended for exportation to other areas.

It would not be possible here to go into the details of all the various projects undertaken by ORD. Instead, only two of its projects that precede but are directly linked to the STARPAHC project will be discussed—the Health Information System (HIS) and the Community Health Medic (CHM) program. Both of these projects figured prominently in the selection of the Papago Tribe as the test site for the IMBLMS project. The Sells Service Unit will also be described because of its unique position in ORD and its essential role in STARPAHC as the primary source of health care for the Papago.

Health Information System. One of the first projects of HPSC had been the development of a Health Information System (HIS) to support their research and development efforts and to improve the delivery of services. Prototype operations were begun at Sells Service Unit in 1969.

During the prototype period of operation HIS provided computer "printouts" to Public Health Nurses and environmental groups as well as medical summaries which were given to physicians and nurses. The first summaries consisted of patient identification, demographic data, records of the last five inpatient and outpatient visits, locations of visits, and resulting diagnoses and medications. Later, the summaries included all known patient health problems, inpatient and outpatient encounters, and surveillance data. The surveillance data were part of a program which utilized a set of minimum health surveillance requirements, including immunizations, skin tests, laboratory tests, X-ray, and special examinations and histories that were scheduled for all members of the population as a function of age and sex. These requirements have aided in the early detection of health problems and have made it possible to identify disease specific high-risk patients.

The files of patients had been maintained on medical tapes and discs at the Bell Aerosystems computer facility in Tucson and are now at the IHS Albuquerque and Data Processing System Center and are directly accessible through remote teletypewriter terminals located at medical clinics in San Xavier, Sells and Santa Rosa. The information in the HIS data base is organized into functional categories by patient. The organization of the file is presented in the following outline.

HIS Data Base Organization

Personal ID
    Personal Identifiers
    Demographic Record
    Alias Record
    Previous Addresses
    Health Record Numbers
    Communicable Disease Contract Record
    Communicable Disease Source Record
    Problem Lists
    Problem Notes

- Encounter Records
    - Medicaid Eligibility
    - IHS Inpatient
    - IHS Outpatient
    - PHN
    - CHS (Contract Health Services) Hospitalization
    - CHS Other
    - Providers of Service
    - Clinic Times
- Future Scheduled Encounters
- Development Record
    - Birth Record
    - Measurements Record
    - Eyeglass Prescriptions
    - Tonometry Data
    - Examination Record
    - Audiometry Record
- Obstetrical Record
    - Current Pre-natal
    - Family Planning
- Medical Profile
    - Purpose of Visit
    - Operations
- Medications and Allergies
    - Medications
    - Allergies
- Immunizations and Skin Tests
    - Immunizations
    - Skin Tests
- Clinical Laboratory Tests
    - Lab/X-ray Tests Ordered
    - Lab/X-ray Test Results
    - Drug Sensitivity Data
- Registry Records
    - Generalized Register Record
- Telecommunications Evaluation
    - Satellite Evaluation - Provider (special program to support Alaska Area IHS participation in applied technology Satellite 6 Telemedicine experiment)
        - Satellite Evaluation - Consultant
    - STARPAHC Evaluation Record
- Special Surveillance Records
    - Hypertension Surveillance Records
    - UTI Surveillance Records
- Surveillance Records
    - Immunizations
    - Skin Tests
    - Lab Tests
    - Examinations

All information in the files is coded for selective retrieval. The information that is entered into the data base and/or retrieval is of a multi-disciplinary nature. Physicians, dentists, pharmacists, social workers, disease control workers, and sanitarians represent only a partial list of users. All tribal programs use this system, as well. For example, percentile measures on children are used to identify target populations for special nutritional programs.

The Community Health Medic Program. The CHM training program was established in 1970 to provide advanced training for an extended clinical role for indigenous persons without a M.D. degree. It was intended to produce trained Indian personnel to serve in small health centers, health stations and small outpatient departments. With regards to both admission standards and curriculum, the CHM program compares rather favorably with other physician assistants or Medex training programs in universities. It has accreditation from the AMA. Requirements for admission include three years of clinical experience, one of which must be in an ambulatory care setting plus one year of special curriculum in the health sciences. These standards rule out the average military corps men, unless of course they had additional training or experience. In addition, the program was restricted to persons of Indian heritage.

The CHM trainees are expected to spend one year at the Phoenix Indian Medical Center and the following year at the Indian Health Service Unit. Training during the first year consists of lectures, demonstrations and seminars, followed by immediate clinical experience. Students rotate through five major health problem areas: maternal health, child health, infectious and communicable diseases, mental health, and accidents—reflecting major health needs among the Indians. The curriculum focuses on the 20 most common conditions of ill health that afflict American Indians. In addition to these clinical areas, there is also special emphasis on problems of delivery of health care dealing with organizational issues, accessibility to care and the like and school health.

The second year is spent in practical training (similar to a preceptorship) and concentrates on clinical skills with special emphasis on remedial training. Trainees work under the supervision of a physician, and more time is spent in areas in which the trainee is found to be deficient. Determination of deficiency is made by a formal evaluation of performance. The most competent performers are accorded more independence in their work. The details of the curriculum are provided in outline form as Appendix A to this chapter.

This training program enables the graduates to perform a complete medical workup of patients, including medical history taking and physical findings, and suggestion of diagnosis. However, they are not responsible for making a diagnosis, irrespective of their ability to administer the needed care until the patient can be moved to a hospital. Physicians working in the system generally reported that CHMs work well under the direction of a remote physician via telephone, radio or TV.

By the time STARPAHC came into being there were two Papago graduates of the CHM program; one was the first to run the Mobile Health Unit. Figure 10 is a picture of a CHM examining an infant in the STARPAHC Mobile Health Unit.

Service Facilities. The Sells Service Unit of the IHS is the primary source of health care for the Papago people. It operates an American Hospital Association accredited 40-bed hospital at Sells, two smaller health centers at San Xavier and Santa Rosa, and a field health program. The Sells Service Unit also provides an environmental health program which is responsible for construction and maintenance of sanitation facilities, as well as consultation and education related to the environmental aspects of disease control.

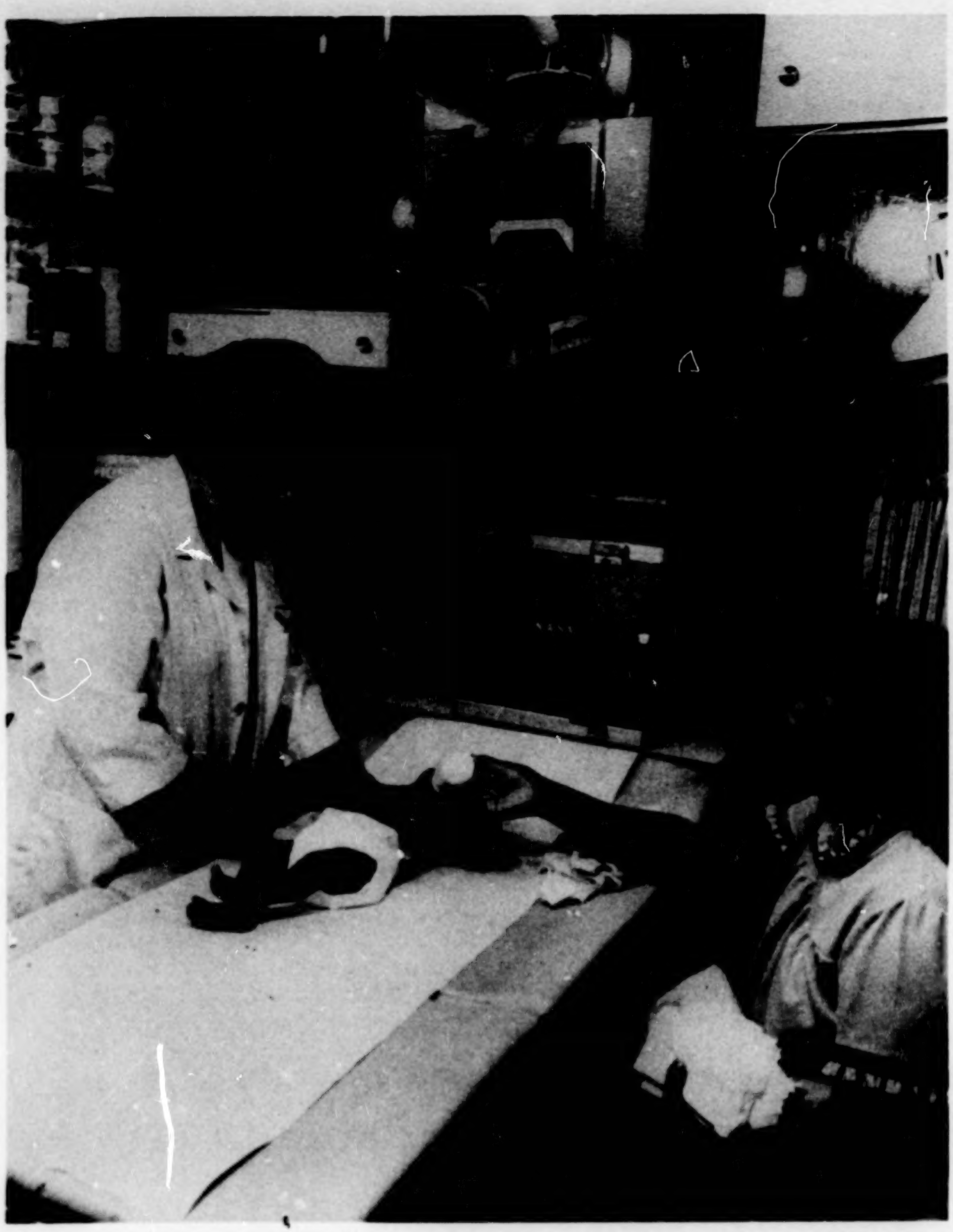


Figure 10: Community Health Medic at work in the STARPAHC Mobile Health Unit

The Sells Service Unit is unique among the other 86 service units of IHS because it is one of three major divisions of the IHS Office of Research and Development. It is often utilized as a demonstration site where new concepts and methods of health delivery are field-tested for application throughout IHS facilities in the United States, but always in coordination and agreement with the Papago Tribe.

The main health care facility of the Sells Service Unit is Sells Hospital. The hospital has seven physicians who perform all ward duties as well as conduct an eight-hour general clinic four days a week and an additional four hours once a week. In addition to the physicians there are at least three CHMs on the staff. The nursing staff consists of twenty-six persons: two Administrative Registered Nurses, ten Registered Nurses, seven Licensed Practical Nurses, six Nursing Assistants, and one Ward Clerk.

The Sells Hospital has an outpatient department which provides transportation to and from twenty outlying villages. On a monthly basis, its transportation schedule averages 155 miles per trip. Patients needing surgery are transported to the Phoenix Indian Hospital. The hospital staff coordinates a variety of other Papago services. These services include: a Field Health Service (alcoholism, TB, rheumatic fever, diabetes, and venereal disease programs), Papago Psychological Service (operated and staffed by the Executive Health Staff), Public Health Nursing Program, Health Education Department, Social Services, Environmental Health Department, Dental Department, and the Santa Rosa and San Xavier clinics. (The Papago Psychological Service Program was called upon by the Australian Ministry of Health for consultation and advice in the establishment of psychological services to Australian aboriginies. An Australian aborigine, who was also a Public Health Nurse, came to the reservation for special training.)

The Santa Rosa Clinic is located in the second largest village—30 miles northwest of Sells. It serves the western and northern areas of the reservation. The main functions of the clinic are outpatient medical services, emergency care, and public health and sanitation activities. Its staff includes one CHM, one Clinical Nurse, one Public Health Nurse, two Driver Custodians, and one Sanitation Aide. The clinic is equipped with an X-ray unit, small lab, and a two-chair dental office. In 1971 it was providing bi-weekly clinics for each village and twice a month clinics at Pisinimo, Chui Chu, and Vaya Chin.

The San Xavier Clinic began in 1965. Its staff includes two Medical Officers, a Public Health Nurse, a Registered Nurse, a Licensed Practical Nurse, a Pharmacy Practitioner, a Health Records Clerk, a Laboratory/ X-ray Technician, and a Sanitation Aide. The clinic functions in manner similar to the Santa Rosa Clinic and participates in youth and health education programs as well. The clinic provides a setting for public health seminars and training for student nurses from the University of Arizona. The staff also conducts health career progams for high school students and a Candy Striper program.

The Phoenix Indian Medical Center is the primary referral source for the Sells Service Unit. It is a fully-accredited GMS hospital with specialty in General Plastic and Orthopedic Surgery; Ophthalmology; Ear, Nose and Throat; Obstetrics and Gynecology; Pediatrics; and Internal Medicine. It has 193 beds and a staff of more than four hundred and fifty. It also served as one of the primary training centers for the IHS Community Health Medic program.

ORD and the Initiation of STARPAHC

The Director of the Office of Research and Development, together with the Chairman of the Papago Tribe, submitted a joint application to the Chairman of the Site Selection Board on

November 27, 1972 for the consideration of the Papago Reservation as the demonstration and test site for the IMBLMS project. In the application, specific responses were provided to each of the items in the guidelines issued by HEW & NASA in the usual manner, demonstrating the unique qualifications of Papago organizations, especially the Executive Health Staff, the environment, topography, transportation network and utilities extant in the desert as well as the contributions of the ORD/IHS with manpower, facilities and data system. Both provider and consumer acceptance were assured, the first through discussions with staff of the Sells Service Unit and the Phoenix Medical Center and the latter through a comprehensive review with the Executive Health Staff, the Tribal Council and the endorsement by the Chairman of the Tribe. It was further indicated that aspects of the system which were proven cost-effective would have long term support by the IHS and the Papago and perhaps then be expanded to other IHS areas and service units. Special emphasis was put on the demonstrable need of dispersed population lacking access to care and the potential contribution of the AHSFU technological backup to reduce the barriers of space and time.

Therefore, the Papago presented strong credentials and a demonstrable need for a telemedicine system to the Site Selection Board. The tribal population as well defined geographically—within reservation boundaries—and well understood epidemiologically—through the Health Information System; communication and transportation constituted crucial problems on the reservation; the community supported the project; and, in addition, the Indian Health Service was considering not only its continuance on the reservation but also its exportability to their other service areas. While the other candidate sites demonstrated need, the success potential—namely, achieving all project objectives greatest at this site. Needless to emphasize, the existence of ORD and the nature of the working relationship they had developed with the Papago probably tipped the scales in favor of the reservation.

Summary and Conclusions

Responsibility for health care for American Indians and Alaskan Natives was assumed by the Indian Health Service in 1955. Previous to that, all Indian services were handled by the Bureau of Indian Affairs in the Department of the Interior. The IHS moved quickly trying to close the serious gap in health manpower and health facilities to accomplish its stated goal of raising health levels among Indians and Alaskan Natives to the highest possible level. However, it was additionally realized that Indians had to be actively involved in managing their own health affairs and had to accept some concepts and practices of Western medicine if the IHS was to succeed in its mission.

The reorganization that followed created five offices—similar to departments—and four divisions—similar to agencies. The pivotal one for our purpose was the ORD.

It may be appreciated that the IHS embarked on its ambitious mission of raising the health status of its service population after Indians had been served by the BIA on a categorical basis without a comprehensive health policy. The IHS assumed strong but positive attitudes toward meeting its objective, even though these were perhaps unattainable. Optimal health status is elusive of definition. It can readily be seen that health can always be improved, and whenever a given level is achieved, rising expectations follow. This is perhaps as it should be, leading to a dynamic never ending process of improvement with built-in structures for redefinition of objectives. Nevertheless, the fact remains that the task for the IHS was formidable. Its service population was suffering from the lowest levels of health as compared to any other group in the United States; was scattered in the most remote and forbidding sections of the country in small clusters on reservations, and lesser concentrations in urban areas; and characterized by variations in culture, traditions, and language. Added to these problems and because [illegible] their cultural traditions, this population was sometimes reluctant to embrace the ways of Western medicine and science.

Perhaps it was the difficulty of the task that generated the comprehensiveness of the approach. Thus, the basic policy adopted by the IHS, and later implemented by the ORD, was twofold: (1.) the use of systems analysis to increase efficiency and effectiveness of programs, such as precise definition of objectives to be achieved, inputs and outputs and assessment of extent to which objectives have been attained, and (2.) meaningful involvement of Indian people in management and provision of health care. Furthermore, to make it all work for the improvement of health status, a broad definition of health influences was adopted incorporating factors such as the environment, nutrition, and mental well-being. Subsequently, in co-operation with Indian people, concerted efforts were made in all areas that affect health status. To this end, training programs were established to equip Indians with the necessary skills and knowledge to carry out administrative and provider functions.

The role of the ORD in these activities was prominent. But in addition to its service as a national resource for the IHS, it had a rather unique relationship with the Papago Tribe. As a close and cooperative neighbor, the reservation was utilized for testing innovative programs, such as the Health Information System. Therefore, it was natural for the ORD to think of the Papago Reservation as its choice for the demonstration and test site of IMBLMS. Nonetheless, ORD was not given the option of choosing the site. NASA apprised ORD about the search for candidate sites, and the fact that the Papago Reservation was being considered among others. This information was relayed to the Tribe.

At least two other Indian communities, as well as competing non-Indian sites, were seriously considered as candidates for AHSFU. However, the homework done by the Papago Executive Health Staff, their effective working relationship with the ORD, and the acute spatial needs of the reservation combined with other attractions stemming from the programs and activities of the ORD comprised a logical choice. The joint effort of the ORD and the Papago lead to its natural conclusion. Finally, while there is little doubt concerning the utility of having the technologic capability of the STARPAHC project on the reservation to address serious problems in access to quality care, hard decisions have yet to be made about the long-term support of these expensive systems. At least in the short run, the answer may lie in identifying the proper technology-manpower-service combination that would yield the most diversified health service, provided by the most available medical personnel, utilizing the least expensive telemedicine equipment.

APPENDIX A

OUTLINE OF THE COMMUNITY HEALTH MEDIC PROGRAM

Course Title	Course Objectives	Lecture	Practical Experience
Clinical Application of Anatomy & Physiology	1. Review man's functions both in health and disease. 2. Discuss body systems as to correlate key concepts of basic science and their application to clinical medicine.	18 hours	
Dental Instruction for Community Health Medics	1. Recognize common oral diseases with indications for referral to a dentist. 2. Know simple techniques for emergency care and initial management for infections and trauma. 3. Know principles for preventive dentistry. 4. Know Indian Health Service dental programs and priorities for dental service based on age and other factors.	12 hours	1 week
Ear, Nose and Throat (E.N.T.) Instruction for CHMs	1. Recognize and differentiate between normal and abnormal findings on routine ENT examinations. 2. Institute proper therapy for otitis media, strep throat, and other commonly encountered conditions. 3. Recognize indications for, and make referrals to a physician when indicated.	3 hours	2 days
Basic Laboratory Skills	1. Use microscope. 2. Collect and transport specimens. 3. Know parisitology of common intestinal helminths. 4. Know laboratory safety, including disinfection. 5. Know media preparation. 6. Know weights and measures. 7. Know staining techniques. 8. Know screening techniques for bacteriological diagnosis. 9. Know the normal location of bacterial organisms in the human body. 10. Know basic principles of hematology. 11. Know basic principles of urine analysis.		80 hours
Principles of the Medical History	1. To prepare the student for satisfying the legal and professional standards necessary for recording directly in the patients unified health record.	34 hours	46 hours

Course Title	Course Objectives	Lecture	Practical Experience
Medical Department Instruction	1. Perform a complete medical history and routine physical examination on an adult patient with accurate collection of data concerning the patient's condition. 2. Recognize and manage certain common medical conditions, such as: uncomplicated diabetes, uncomplicated arteriosclerosis, gastroenteritis, common upper respiratory conditions, gonorrhea, etc. 3. Know indications, preliminary preparations and guidelines for referral to a physician concerning conditions such as congestive heart failure, cardiac arrhythmias, tuberculosis, other severe infections, various metabolic disorders and all other complicated conditions not understood by the CHM.	63 hours	1 month
Nutrition and Diet Therapy	1. Know and understand basic nutrition principles. 2. Adapt nutrition and diet information to real life encounters (emphasis on diet therapy in the treatment of disease).	16 hours	
Obstetrics-Gynecology Department Instruction of CHMs	1. Follow the progress of a patient in labor and be able to deliver a baby in an emergency. 2. Recognize abnormal labor patterns in order to refer to a physician when consultation is indicated. 3. Perform adequate initial prenatal examination — plus prenatal clinic checkups. Recognize abnormal prenatal course and refer to physician. 4. Recognize and deal with emergency obstetric conditions. 5. Recognize both immediate and post-partum complications such as bleeding or sepsis, institute appropriate preliminary measures and refer to a physician. 6. Recognize and institue immediate supportive treatment and make appropriate referral in potentially life threatening situations such as incomplete abortions, suspected ectopic pregnancy, and abnormal bleeding of the type which points to possible carcinoma of cervix or endometrium.	19 hours	1 month or more

Course Title	Course Objectives	Lecture	Practical Experience
	7. Perform an educational role in patient counseling relative to various modalities of family planning services.		
Outpatient Practice and Field Health Services	1. Perform 48 skills related to the outpatient clinic on the *Proficiency Certification of CHM Trainees*.		
	a. Supervised evening and weekend emergency duty at Phoenix Indian Medical Center.		500 hours
	b. Regular outpatient clinic duty during the day at Phoenix Indian Medical Center.		1-3 months
	c. Attend at least 10-12 field clinics in small communities.		
	d. Perform physical exams, skin tests, immunizations and other school health activities at clinics.		
Pediatric Training	1. Care for well infants and children.	14 hours	3-8 weeks
	2. Diagnose and treat common minor pediatric illness and abnormalities.		
	3. Recognize and give emergency care of serious pediatric conditions which require evacuation to a hospital.		
Pharmacy Staff Instruction to CHMs	1. Know basic medical calculations.	48 hours	
	2. Know the pharmacology of drugs — especially use of oral antibiotics and drugs used in emergencies.		
	3. Instruct patients in proper use of medicine and answer simple questions.		
	4. Write prescriptions and perform certain pharmaceutical skills such as filling prescriptions, proper storage of medicines, legal requirements for controlling drugs, and proper method of inventory control.		
Public Health Nursing	1. Know the role and function of P.H.N.	8 hours	
	2. Know the what, why and when of scheduling immunization clinics.		
	3. Know referral to P.H.N. and other county and state agencies.		
	4. Know role of CHM in school health programs.		
	5. Know P.H.N. teaching and demonstration.		
	6. Know health surveillance of P.H.N. in the home.		

Course Title	Course Objectives	Lecture	Practical Experience
Radiology Department Instruction of CHMs	1. Relate facts about production of X-rays to specific safety requirements for protection of operator, patient, and others in the environment. 2. Properly position patient for roentgen examination. 3. Describe the most common clinical signs that justify X-ray examination and how each position may result in important information. 4. Recognize artifacts due to faulty techniques and offer suggestions to avoid them. 5. List the limitation of X-ray examinations with respect to diagnosis of certain common syndromes.	8 hours	16 hours
Social Service Practices	1. Familiarization with: a. Stages of personality development. b. Purpose and techniques of interviewing. c. Referrals and use of community resources. d. Normal growth and development of children. e. The exceptional child. f. Historical review of social and health programs affecting Indian history. g. Present development of Indian directed health programs. h. Families in crises in relationship to death, accident, separation, and prolonged illness.	9 hours	
Symptom Manifestations	1. Know the most common symptoms which patients will present to a CHM in a primary health care situation. 2. Evaluate and assess the significance of these symptoms. 3. Develop an appropriate plan for investigation, diagnosis, and management relative to each symptom to determine the underlying condition to which the symptom relates.		
Basic Medical Mathematics	1. Know conversion from English to metric system, fractions, proportions, calculations of drug dosages, and elementary statistics.	0-14 hours	
Principles of the Physical Examination	1. Record findings. 2. Examine head and neck.	40 hours	

Course Title	Course Objectives	Lecture	Practical Experience
	3. Examine eyes, ears, nose, and throat. 4. Examine chest, lungs, heart. 5. Examine abdomen. 6. Examine extremities. 7. Examine nervous system.		
Seminar on Inter-Personal Relationships	1. Examine feelings of students about the role of the CHM in relation to patient care, authority and professional direction, being the middleman between two cultures, etc.	40 hours	
Mental Health Training for CHM	1. Know mental health and treatment for conditons such as drug abuse, alcoholism, retardation, stress, etc.	160 hours	
Elements of the Hospital Health Team	1. Be familiar with the methods, skills, and professional training of the various members of the health team.	46 hours	
Advanced Medical History	1. Identify certain constellations of patient's plus physical findings and specific items from the medical history as diagnosis. 2. Describe and record physical findings. 3. Know the range of disease manifestations for the most common illnesses.	111 hours	600 hours
Community Health	1. Work with groups of lay people in areas of health planning, coordination of resources for health education, and community development and related topics.	73 hours (workshops)	
Physical Therapy Instruction for CHMs	1. Know the types of treatment available and indications for each type of therapy. 2. Know measures to prevent patient complications related to physical therapy.		2 days
Opthalmology Department Instruction for CHMs	1. Recognize and differentiate between routine eye problems and emergencies. 2. Manage emergency eye problems and prepare for referral to a physician. 3. Know terminology for describing eye conditions in order to facilitate telephone consultation and referral to a physician.	6 hours	3 days

BLANK PAGE

BLANK PAGE

Chapter Four

THE PAPAGO PEOPLE

It is now pertinent to describe the historical and cultural roots of the people who embraced the STARPAHC project and came to view it as an integral part of their health care and communications system. There is no intention here to give a detailed history of the Papago people, who refer to themselves as Tohono O'Odham — The Desert People, nor to completely describe the characteristics of their culture. Rather, it is intended to highlight significant characteristics of the people, their history, and their environment, in order to shed some light on the Papago point of view and their role in the development of and reaction to STARPAHC.

The long and rich history of the Papago provides the cultural background of the community where STARPAHC was implemented and integrated into reservation life. The historical and cultural foundation of the people reveal the consistent manner in which they have responded to the external challenge of social change, and yet have tried to preserve a cherished way of life.

The Papago have long-standing traditions, but among these traditions is a willingness to deal realistically with new situations. Indeed, the strong traditions of the Papago culture incorporate sufficient flexibility to handle modern problems and modern technologies. This skillful blend between the traditional and the innovative tends to understate the Papago concern with the preservation of a way of life that is threatened with much change, if not obliteration. Although the Papago want to share in the bounty of the dominant culture outside the reservation, they do not want to do so indiscriminately or without regard to their system of beliefs and values.

The coming of STARPAHC to the reservation provided a stark contrast between high technology and a relatively stable Indian culture rich in tradition, and hence the uniqueness of this project. Indeed, it combined two faces of America, the most advanced telecommunications technology, telemetry, and computer science interacting with a culture that prevailed on this continent thousands of years before the advent of the white man. Some Papago believe that the coming of space technology to the reservation was predicted by the Medicine Men, but whether or not they truly predicted STARPAHC, the fact remains that there is a strong sentiment that a common meeting ground between the two cultures — the technologically-oriented one of the "white man" and their own — was perhaps inevitable.

Through active participation in the STARPAHC project, the Papago have demonstrated a very serious interest in what this technology can offer their people. The tribal representatives who were members of the Executive Health Staff diligently participated in all the preparatory design meetings pertaining to this project, learning the basic terminology to deal intelligently with each issue put before them on the discussion table, be it related to the design of the mobile health unit, power generation for the relay stations, or the broadband/narrowband choices in transmission and display equipment. Their active involvement in every phase of the project is rare in similar situations where a new project is implanted in a community by an outside agency. The Papago insisted on, and they achieved, an explicit acknowledgement of their own primary health objectives, namely, to live as a people in harmony with nature, as the primary objective of STARPAHC. The evaluation plan developed for STARPAHC recognized the Papago objective as the project's basic objective.

Some who were not intimately connected with the project characterized the Papago as

BLANK PAGE

BLANK PAGE

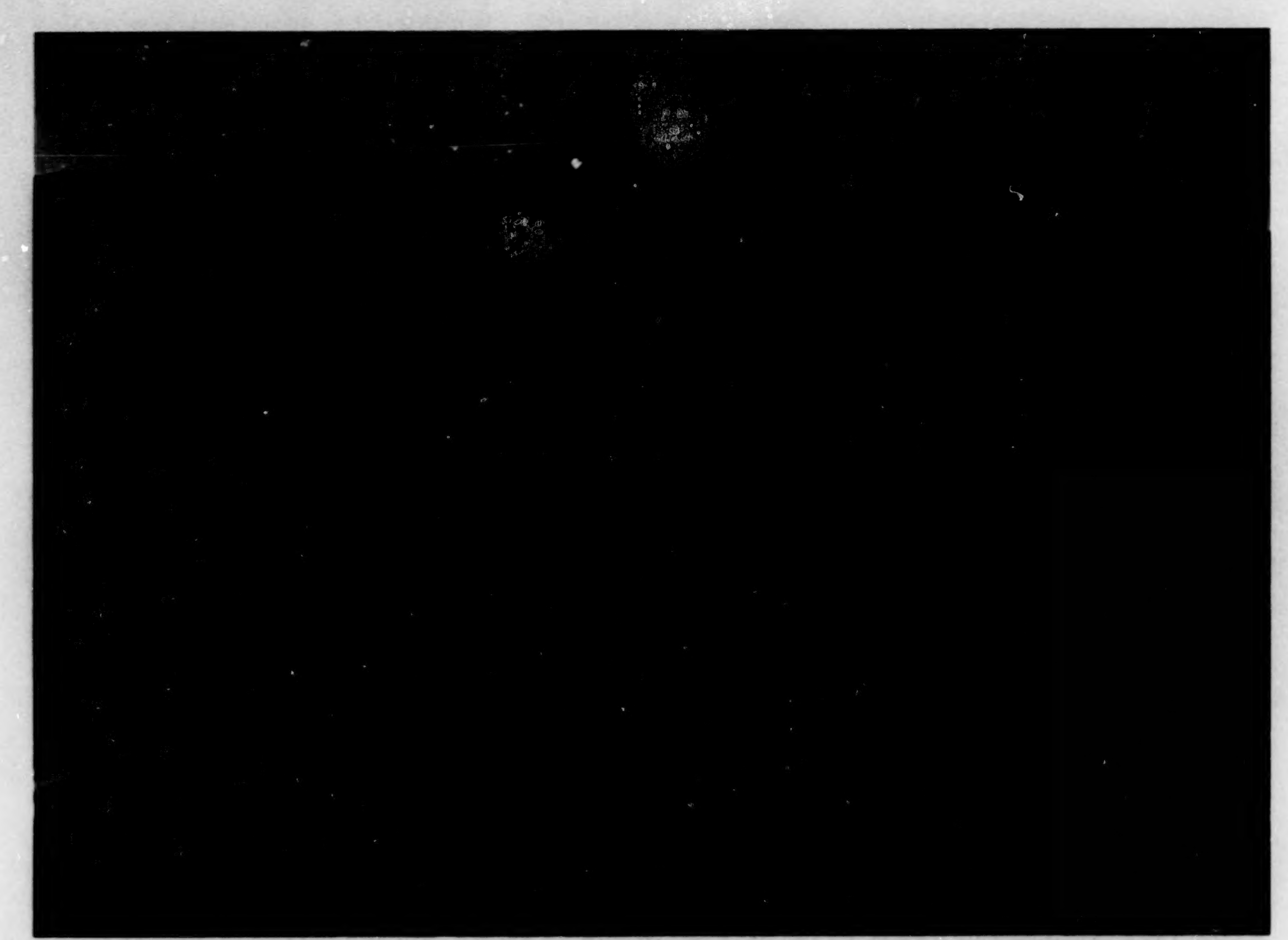


Figure 11: Looking South to Mexico from the Village of Ali Chuk, Gu Vo District, Papago Reservation

objects with little say or influence in securing the project or dealing with it once it was there. Hence, it was argued that the Papago were passive recipients of a NASA/DHEW demonstration of sophisticated hardware. However, this was not the case; the Papago had the power to reject the project if they did not want it. The Papago's primary concern was that STARPAHC's introduction into reservation life should serve the purposes of the Papago culture and the Papago people. They gently but convincingly asserted themselves in order to ensure that no short-term gain in new or incremental health services or communications technology that may be derived from the project be offset by long-term problems or hazards, such as disturbing the ecological balance or harmony with the natural environment. In return for furnishing new services on the reservation, the federal agencies were allowed to perform whatever experimentation or demonstration activities that they desired for technical development—according to Papago prerequisites and stringent controls.

This brief account of the history and culture of the Papago should reflect a people who have admirably adapted to what must be considered a severe environment and a people who, though characterized by modest circumstances and a strong sense of tradition, are nevertheless involved in the forefront of innovative experimentation related to man's last frontier, outer space, and the innovative arrangements for the provision of health services through sophisticated technology.

History and Culture

Throughout their history the Desert People have lived in the desert southwest of the North American continent. Their home (Papagueria) in the basin and range region of the Sonora Desert of southern Arizona receives little rainfall—most of this torrential and occurring in the summer months, thus posing threats of flashfloods. The surrounding mountains are the source of some moisture and do provide some respite from the intense summer heat. In contrast to other groups, their seasonal migrations took them to the low lands in the summer and the foothills in the winter where they have permanent springs. Hence, the fields constituted the summer village and the springs the winter village.

The area is one of the hottest and driest in the country — temperatures in the summer often exceeding 100° F and sometimes soaring to 120° F. Figure 11 shows the terrain typical of the southwestern part of the reservation. This severe environment has had its advantages, however, in that throughout recent history the Papago have been relatively isolated from Western European impact and the "opening up" of the American West. As we shall see later, this may strongly contribute to the receptivity of the Papago to selectively adopt those western ideas and technology (including STARPAHC) that provide assistance to them.

Prehistory. Current archeological evidence indicates that man has lived in the region of the Papago for some ten thousand years. The earliest people were semi-nomadic hunters and gatherers, hunting wild animals (e.g., bison, sloth, tapir) and gathering wild seeds and roots for food. Evidence collected from excavations in the northwestern part of the Papaqueria points to the development in the first century A.D. of a sedentary agricultural population capable of cultivating corn and skilled in the making of pottery, and several cave locations proved to be excellent for the preservation of cultural artifacts. Later remains, including human mummies, cotton textiles, sandals, and baskets, provide evidence of the linkage of the Papago tradition with the more general Hohokam ("finished" or "gone") culture which was widely spread over the Southwest during that same time period.

Spanish-Apache Period. Little is recorded about the people of this area from 1400 until 1698. This period is known as the "dark age," but it is believed that the Hohokam culture was maintained by the Desert People. The first documented contact of the Papago with the European culture was at the end of the 17th century through the explorations of Spanish Jesuit priests in their attempt to establish missionary programs in the desert Southwest. Jesuit writings describe contact with seven groups of Indians in the region, each group speaking a dialect of the Piman language. Five of these groups were identified as Papago. They were described as a peaceful people living in small agricultural villages scattered throughout the Papagueria.

In accommodating to the severe environment of extreme aridity and the associated lack of flowing streams and other natural bodies of water, the Papago soon adapted to these conditions with considerable ingenuity. They planted their fields at the base of steep slopes in order to capture runoff from torrential, summer rain, dug irrigation canals, and collected and stored water from flashfloods for subsequent watering of crops.

The economy of the Papago was altered by the coming of the Spanish missionaries in two ways. First, before the missionaries came to the region, the Papago crops were primarily squash, corn, and beans. The Spaniards introduced wheat, kidney beans, lentils, vetch, and chickpeas, adding substantial variety to the Papago diet. Secondly, as is the case with most Indians in the Southwest, the introduction of horses and cattle to the Papago was of great importance. The horses solved transportation problems and the cattle added a steady source of meat. The greater mobility of the Apaches upon receipt of the horse, however, resulted in more frequent raids upon the more sedentary Papago.

Prior to the Apache raids, the Papago had lived in many, rather small, scattered villages of 50 to 60 families. They harvested their valley crops in the summer and in the winter returned to the mountains where the water supply was assured. As their homes were threatened, they began to abandon the small settlements and gather into larger villages for defense—building fortifications and terracing hills. Though they had to follow their migratory cycle to exist, they also had to learn to live closer together and cooperate with each other.

The early Jesuit missionaries hoped for wholesale conversion of the Papago to the Catholic Church. However, in contrast with the missionized Indians, the Papago retained much of their traditional religious values and many beliefs and rites. In 1752 there was general uprising in the Southwest against the Spanish and the Jesuits were expelled in 1767. Later, the Franciscans took up the task and attempted to change the Papago religious system. They too met with limited success for during this period the Papago retained their native priests and earlier rituals through the establishment of the independent Sonoran Catholic Church—a sect without organization or official connection.

Early Reservation Days

The first Papago related reservation, the Pima Reservation, was established in 1874, about 20 years after the Gadsden Purchase. About this same time significant changes were taking place in the life of the Desert People. The development of deep, drilled wells, ranches, and copper, silver, and gold mines de-emphasized the primarily migratory agriculturally-based economy. Some Indians left the Papagueria to work in the mines or on cattle or sheep ranches. Though quite temporary, many small mines were opened and mining towns achieved populations of five and six thousand. These boom towns had regular stagecoach service, post offices and schools.

For the most part, Papago lands were still the property of the tribe as a whole. There was one attempt, however, to allocate land to individuals. This occurred after the Allotment Act of 1891 and was only applied to parts of the San Xavier Reservation. In 1911 other lands were to be allocated. Fortunately, only one of the proposed 2700 allotments was made, since the 160 acres approportioned to each ignored considerations of topography, using the range and township system of the Middle West. This haphazard system of apportioning land offered no protection to the main body of the tribe who lived outside of the San Xavier Reservation. By 1917 the Sells Reservation was formally established, including most of the land now occupied. Congressional Acts in 1926, 1931, 1937 and 1940 authorized the purchase of patented land to be added to the Papago Reservation in addition to inclusion of public domain land.

There were two major causes of change that took place early in the fourth period of Papago history which began in the 1930's: (1.) the Civilian Conservation Corps (CCC) and the Indian Reorganization (Wheeler-Howard) Act. The CCC began in 1933. At first the concept was met with resistance, the older people opposing the idea of young men working for money and predicting a disregard for parental authority, drinking and trouble. Before the CCC ended in 1942 about one man in each 20 families was doing CCC work. The work included building roads to places previously inaccessible except by horse, deepening the diking of Charcos (natural ponds) and drilling of deep wells for water which allowed people to live year round in the valley villages. Importantly, the young men could now buy food and need not be tied down to the fields.

In 1937 the Indian Organization Act and Tribal Constitution were placed before the tribe and approved. The Papago had always had organization at the village level and there had been various groupings and leaders for particular programs. But now the whole reservation was to be organized on a democratic basis with equal representation in council. Subsequently, the reservation was divided into districts. Since 1937 the Papago Tribal Council has been meeting regularly and handling much of the business of the tribe.

Tribal Organization

When the Indian Reorganization Act was ratified in 1937, the Papago Tribal Council was established for the governance of the tribe, and the Constitution and By-Laws of the Papago Tribe, though apparently little understood, were also ratified by the members of the tribe on December 12, 1937. The Constitution is the basic political document that specifies the nature of the political process and decision-making in tribal affairs. The Tribal Council consists of twenty-two members who are elected from the various villages in the reservation. It holds monthly or more frequent meetings, presided over by the Chairman. The Chairman, formerly elected by the council annually, is now elected by direct vote of the people for a term of four years in accord with a recent constitutional revision. A chairman is selected with great care, typically after a person's abilities have been amply demonstrated. Other tribal officials include a Vice-Chairman, Secretary and Treasurer.

For purposes of tribal administration, the reservation is divided into eleven districts — Baboquivari, Chukut Kuk, Gu Achi, Gu Vo, Hickiwan, Pisinimo, Schuk Toak, Sells, Sif Oidak, Gila Bend and San Xavier (see Figure 5). Each district has its own local governing council and elects two delegates to the Tribal Council. There is no sharp distinction between local and tribal affairs, and it is generally assumed that the opinions of the local council in matters pertaining to its area are weighted very heavily if deliberated by the Tribal Council. Hence, decisions affecting the local district are normally shared by the local council and the tribal delegates, unless, of course, the issue is taken up by the Tribal Council.

The Tribal Council has insisted on its sovereignty over the reservation land. The revenue needed to run the tribal government derives from a tax on the sale of cattle, income from leases of tribal land, and licenses for traders and hunters, as well as court fines. More recently, the Tribal Council established entrepreneurial enterprises such as construction, irrigation, and utilities in order to procure various contracts or subcontracts that also yield additional revenue for the tribe.

Early Political and Social Organization

The basic organizational unit of the Papago traditionally has been the village. Until the Indian Organization Act of 1937, the villages were autonomous with no intertribal organization under a single leader. The Tribal Council now represents the interests of all the Papago and deals with both intratribal issues and relationships between the tribe and outside groups.

The residents of each village select a headman on the basis of his accrued respect of the people based on a proven dependability, and a recognized ability to represent every person in the village. His role is seen as the spokesman rather than as a leader of the village. He is expected to express village attitudes instead of forming them. When important decisions have to be made, he calls a village meeting composed of all the adult men. No action upon important matter is taken until the council has reached agreement on the issue. Traditionally, unanimity has been a strong Papago idea—one they usually achieve at the cost of speedy action. Some issues take weeks or months to decide, while others are never agreed upon. Occasionally the Papago have been disturbed by outsiders who tend to push for fast action on decisions without allowing adequate time to reach unanimity.

Communal problems requiring collective action are viewed as everyone's responsibility. Typically, the headman convenes appropriate groups, and specific tasks and responsibilities are delegated to the members according to their abilities. Normally, such tasks and responsibilities are accepted voluntarily in a spirit of cooperation. The Papago share a strong sense of collective responsibility for the major problems that face their community, such as flashfloods, drought, or planning for irrigation. Therefore, the most important issues that face the community are universally viewed as requiring communal action.

In the traditional system, there are several other important persons in the village in addition to the headman. These included the Keeper of the Smoke, the Village Crier and, of course, the Village Council of Elders. These leaders have specific responsibilities during various ceremonies and festivals. This strong tradition of collective responsibility and group process was vividly demonstrated in the procedures that were followed in the presentation and final approval of AHSFU/STARPAHC, to be described later in this chapter.

The traditional Papago religion stems from their agrarian character and a very close association with the cycles of nature. This is exemplified by two of the most important ceremonies occurring annually: the rain ceremony of early summer and the deer dance of late autumn and early winter. As might be expected, the most important ceremony was associated with agriculture — the Vickita — a harvest festival, which was celebrated every four years. Now a wine feast is celebrated in August every year. (The wine is prepared from fermented fruit of the giant saguaro.)

Typical of many traditional societies, the family system among the Papago is extended and patriarchal. Typically three generations live in the same household with the parents and their children as well as the wives and children of sons sharing the residence. This gives a special role of prominence to the senior male and general respect for the elders in the community. Nonetheless, women also occupy important roles and assume direct responsibility for the family's well-being.

The concept of village autonomy is extended to the family, and each is responsible for its own subsistence. As long as the family is capable to assume this responsibility, it is left alone to manage its own affairs. However, when in need, such as in times of harvest or in case of a calamity, others in the community contribute. Hence, there are two circles around the individual's life pattern, the family and the village. Beyond that the concept of the external world is very limited and has no direct bearing on one's daily life. Of course, this has been true in the past, but even with the foreboding nature of the desert from which this concept emanates, it is breaking down with increased contact with the outside world. The family was and continues to be an important social unit. Its role as an economic (or productive) unit has diminished. Several family members now work outside that unit in various productive capacities, thereby bringing an end to a traditional pattern that persisted for several centuries. Despite these changes, emphasis is not placed on individual performance or achievement. Hard work, perseverance, frugality, and individual initiative are qualities of a good person, but the emphasis is on the community rather than the individual. Indeed, the Papago value better homes, improved education and health but not specifically for individuals. It is the improvement of the community as a whole that is crucial for them. The motivation to increase possessions for the individual is not prevalent in the Papago culture. It is not a consumer-oriented society.

Early political changes in "control" of the desert Southwest affected the Papago very little. The thirty-year struggle for Mexican independence culminating in 1821 had more effect than the direct contact with the Spanish social influence through the various missionaries. The Papago were given guns, horses, and food for their help against counter-revolutionaries and against the Apache. Some Papago villages were broken up and there was racial intermixture. This occurred principally in the southern part of the Papagueria which is now part of Mexico. The northern and western portions, even through this period, remained isolated. In 1853 the Gadsden Purchase marked the transfer of jurisdiction of the Papagueria to the United States, and even then for two decades the northern and western Papagueria was largely unnoticed. The first Indian agent was appointed in 1870. During this period the Papago ownership of the Papagueria was, of course, not filed and soon western ranchers and settlers claimed many springs, wells, and grazing areas of the Papago. Before the Papago could put an end to this occupation, a good deal of the fertile desert land was already taken away.

The Economy

As mentioned at the outset, the severe environment in which the Papago live has never provided abundance. Despite some bright prospects for future economic development, the Papago Tribe, when measured on a per capita income basis, has never been among the richer tribes in the Southwest. For example, the per capita income on the reservation in 1973 was approximately eight hundred dollars.

Funds from federal sources, as well as from private industry are becoming more available for developing local projects. These help somewhat to reduce the unemployment problem and to increase the basic working capital of the tribe. While it is clear that the basic problem of poverty and unemployment remain largely unresolved, the Papago point rightfully with pride at the progress recently achieved in these areas. Water development and maintenance projects should substantially increase the productivity of agricultural land. Thus, at least some of the low yield and idle land is expected to become productive through irrigation. The severe drought conditions (1976-1977) in the entire Southwest may frustrate some of these local efforts, especially if some of the large scale water diversion projects are halted, as requested by the President of the United States. A new 2½ mile long earth dam was under construction. Its success will mean that thousands of acres, heretofore idle, will be cultivated, thereby enabling the Papago to multiply their agricultural productivity mainfoldly. Other benefits accrued from the water project will be the development of campgrounds, fishing and recreational parks, from which additional income will be derived. Management training provided by the Bureau of Indian Affairs and by the University of Arizona and county extension courses should enable the Papago to make better use of the newly-completed water projects. In addition, upgrading the grazing range through new clearing and seeding techniques is enabling the tribe to support more cattle per acre, thus increasing the income from both tribal and privately owned herds on the reservation.

The Papago Tribe now has its own construction department which engages in light construction work on the reservation. The major activities to date have been new homes and community buildings, warehouse construction, and, under special contracts, projects such as the microwave relay station and site improvements necessary for the stationing of the STARPAHC Mobile Health Unit. The Papago Tribal Utility Authority eventually will provide electrical power to houses and businesses on the reservation as well as to private industry. Its net revenues will accrue to the tribe as a whole.

Other tribal enterprises include the development of firefighting capability, the Annual Papago Tribal Rodeo and Fair, and the Arts and Crafts Co-operative in Sells. The activities and success of this latter organization is of special importance to the Papago people because a substantial volume of sales of their artistic baskets each year signifies recognition of traditional skills of the Papago by non-Indians. Indeed, the resurgence of interest in these uniquely designed baskets has inspired the teaching of old arts, crafts, and skills in reservation schools and the search for markets beyond the reservations.

Once considered poor in mineral resources, the Papago land has been reassessed since the discovery of copper on reservation land within the last decade. Three private mining companies — Hecla, Newmont, and American Smelting and Refining—are utilizing this resource as well as providing for local employment. The training for these jobs is being offered by the Bureau of Mines at the Papago Mining Institute on the reservation. Besides the employment opportunities, the tribe receives more than 3 million dollars annually in royalties.

Therefore, it can be seen that the economic base of the reservation depends on four sources: (1.) shares of reservation income, (2.) small businesses on the reservation, (3.) local employment, and (4.) cattle.

A critical problem for the Papago is chronic unemployment. Here the Papago find themselves in double jeopardy. Their perspective on working for pay is at some variance from the professed values of the mainstream of American society and they also find themselves at a disadvantage when they do try to compete in that system. In the first place, the idea behind the use of financial incentives as basic motivation for human behavior is recent to their culture. Residents of the reservation who seek jobs off the reservation have not always met with success and the jobs usually available to them are in farm labor. Indeed, the families that leave the reservation in search of jobs typically end up with very low-paying jobs, the remuneration for which barely meet the basic necessities of life. Interestingly, the Papago, as many other Indians, are well known as expert forest fire fighters.

The struggle for mere subsistence is also reflected in acute levels of health care needs such as nutritional deficiency, extraordinarily high prevalence of certain diseases and, until recent years, high levels of infant mortality.

Although the Papago leadership—if not the dominant majority of the people—perceive the need to maintain their traditional style of life and their value system, there is also a growing awareness that complete independence from the social and economic system outside the reservation is no longer possible or desirable. Hence, there is an emphasis on taking what is best from the outside and weaving it into the indigenous system. A few examples should clarify this point of view. In an increasingly integrated society the formal education provided by the "white man" is viewed as essential in learning to make wise decisions, and hence the tribe recognized the need for Western-educated people. To this end, the Papago are supporting scholarship funds and are taking advantage of various special courses provided by government agencies and private industry in the hope that persons who are trained by these programs will render service to the reservation. Also, the Papago are eager to learn managerial and technical skills that would help them to conduct business with companies that have interests on the reservation. They cited their experience in STARPAHC as a notable example in which they learned about operation and management skills that they hope will enable them to reach operational and economic self-sufficiency.

The receptivity of the Papago to adapt to the ways of the "white man" is viewed as a matter of necessity, but its ultimate purpose is to enable the Papago to achieve a reasonable standard of living and, more importantly, eventual self-determination.

The Papago System of Health

The review of Papago history, culture and economy reveals the closeness of the Papago to the land and the environment*. The reservation title is only a symbol of Western domination. Relationship to nature and to an environment unrestricted by reservation boundaries continues to provide the true meaning of life for the Papago. Indeed, the power of the natural environment asserts itself often. Death from flashfloods or droughts are strong reminders and are common occurrences. Illness is viewed as a severe circumstance not only because of the symptoms, but also because of the ill person's ability to help with subsistence (in a sense, the person's productivity) is hindered. As a consequence, an elaborate belief system has been developed in relation to illness.

Reflecting their strong belief in the necessity of living in harmony with nature, illness is explained as a sign that the ill person has upset this balance and offended one of nature's supernatural forces, referred to as "beings". Thus, discovering the cause of illness is more important than the suffering itself. Without this the restoration to harmony could not be achieved and the person would remain ill.

Ill persons are expected to go to the medicine man. After the cause is diagnosed, the patient should go to the appropriate curer. The medicine men are regarded as very important persons in Papago society because they are thought to possess special powers that enable them to discover the cause of illness and prescribe the appropriate cure. Curers are divided

---

* It is commonly reported that when a Papago returns to the reservation after a trip away, the first landmark to be seen from the road is the peak of the Baboquivari Mountain that serves as an assuring reminder that he/she is "home". There is a strong sense of comfort and satisfaction that derives from coming home, and the sight of Baboquivari provides that assurance.

Figure 12: Marilyn Segundo, a Papago Community Health Representative, Examines a Patient

into three classes: singers, herbalists, and masseurs. Each has specific powers and modalities. The singer sings songs which have power to placate offended "beings". The herbalist gives herbs for conditions which have no directly know cause. The masseur uses his power to find and press "misplaced" body parts into their proper location or withdraws foreign objects from the body.

The provision of public health service facilities and Western doctors presented the Papago with an alternate health system which was initially distrusted. This is because they expected the western doctors to be able to diagnose and prescribe treatment just as the medicine men had done before; they did not expect to be questioned or examined. Hence, the conclusion was that the western doctors had very little "power" if they had to resort to such procedures, even though their success in treating the symptoms of illness was acknowledged.

As the Papago were increasingly exposed to western medicine and as the Indian Health Service personnel achieved a better understanding of their beliefs and values, an accommodation evolved between the two systems. Initially this resulted in acknowledgement by the Papago that they shared with the "Anglos" certain common ailments such as colds, coughs, and diarrhea, ("wandering sickness" that affects everyone regardless of age, sex or race). The next major change came about as the result of accepting a special class of illness that was explained by the medicine men as "Anglo illness", such as venereal disease and referring these to the Anglo doctors. Eventually greater co-operation was established between the two systems, whereby referral from one to the other was practiced. The medicine men acknowledged that illness would respond to Anglo medicine but would persist until the offended natural forces or being was discovered and placated. Thus, a mutual accommodation arrangement evolved in which the Anglo doctors were acknowledged to exercise control over symptoms, while the medicine men maintained control over the restoration of harmony. Medicine men were encouraged to visit hospitalized patients, and in some cases the doctors referred patients to the medicine men after their failure to cure an illness. However, over the years the number of medicine men has diminished, even though their therapeutic role continues to be significant in the present health system.

In 1968, the Indian Health Service launched an innovative program aimed at increasing the active participation of Indians in their own health affairs. To this end, the Community Health Representative (CHR) program was established. The tribal leadership, Indian practitioners, and Desert Willow Training Center staff worked together on all aspects of curriculum development. Special efforts were made to incorporate the cultural and traditional values and behavior patterns into the CHR curriculum in order to avoid conflict with existing cultural and social patterns.

In November of 1968, eighteen Papago people (selected by the tribe) representing the different districts on the reservation began basic CHR training at Desert Willow National Training Center. The curriculum was centered around the various health problems which were most prevalent to the Papago, such as tuberculosis, diabetes, trachoma, and alcoholism. Figure 12 is a photograph of a Papago CHR examining a patient.

The introduction of the Community Health Representatives (CHRs) into tribal life had dramatic consequences on tribal health programs. The CHR served as guides or cultural interpreters, explaining the complex and often confusing public health, education, and welfare system to the community. They not only referred persons to the outside agencies, but also helped them to understand the process of contacting and applying for services. In addition, the CHRs were instrumental in identifying common diseases in the community and communicating the community's needs to the staff of the Indian Health Service. Because of their success in identifying these needs, many specialty CHR training programs were established.

Thus, for the first time, the tribe had a cadre of trained mid-level health workers who understood the working of the Anglo medical care system but has also mantained close ties with Indian culture. As a result of this, the Chairman of the Tribal Council appointed the first subcommittee on health. This was composed of six members from various districts of the reservation who worked closely with the Chairman and Indian Health Service personnel. The subcommittee functioned until the Spring of 1971 when it gradually became inactive after it had submitted its recommendations.

By April 1971, the Papago Tribe found itself managing a growing number of programs made possible by federal and tribal resources through the CHRs. The Tribal Chairman recognized a need for the development of a tribal organization which could coordinate the proliferation of health programs of the tribe and the IHS.

By the fall of 1971, the reservation had six operational health programs: Community Health Representatives (CHR), Emergency Food and Medical Services (EFMD), Papago Nutrition Improvement Program (PNIP), Papago Psychological Services — usually called Mental Health (MH), Alcoholism Prevention and Education, and Otitis Media. Hence, an ad hoc committee, consisting of Papago Tribal staff members, ORD personnel, and a public health consultant, was appointed to investigate various health organization models.

In addition, the directors of the various health programs began meeting informally to exhange information about their programs. Gradually the group developed a method of co-ordinating and planning health services. Their organizational system was based on the traditional Papago group decision-making process, whose primary objective was consensual agreement of all concerned parties. It was called the *Bith Haa*, literally clay or cooking pot. It should be pointed out that it was different from the traditional organizational structures which were explored by the ad hoc committee, and the Tribal Council had its input to the organizational design.

The directors met with the Tribal Chairman on March 8, 1972, and presented him with a preliminary plan for coordinating their health programs. They explained their idea of the *Bith Haa* organization and suggested the development of an Executive Health Staff (EHS).

In July 1972, the Papago Tribal Council passed Resolution No. 43-72 to establish the Executive Health Staff which was authorized to initiate action, formulate policy, examine health matters, manage, coordinate, implement and administer tribal health programs. It was resonsible for advising the Tribal Council on health matters and also for communicating with outside agencies. The members of the Executive Health Staff were to consist of the directors of the health programs and a tribal advisor (an outside health consultant).

The following is the main text of the resolution:

WHEREAS, The Papago Tribal Council has as one of its objectives to improve the health of the Papago people by providing health services and programs consistent with the goals of the Papago Tribe in developing its human resources; and

WHEREAS, the Council is desirous of developing health systems that are applicable and consistent with the positive involvement of Papagos; in order to offer alternative choices in health care and to provide educational information concerning health programs or services; and

WHEREAS, in order to accomplish these stated objectives, it will be necessary to develop

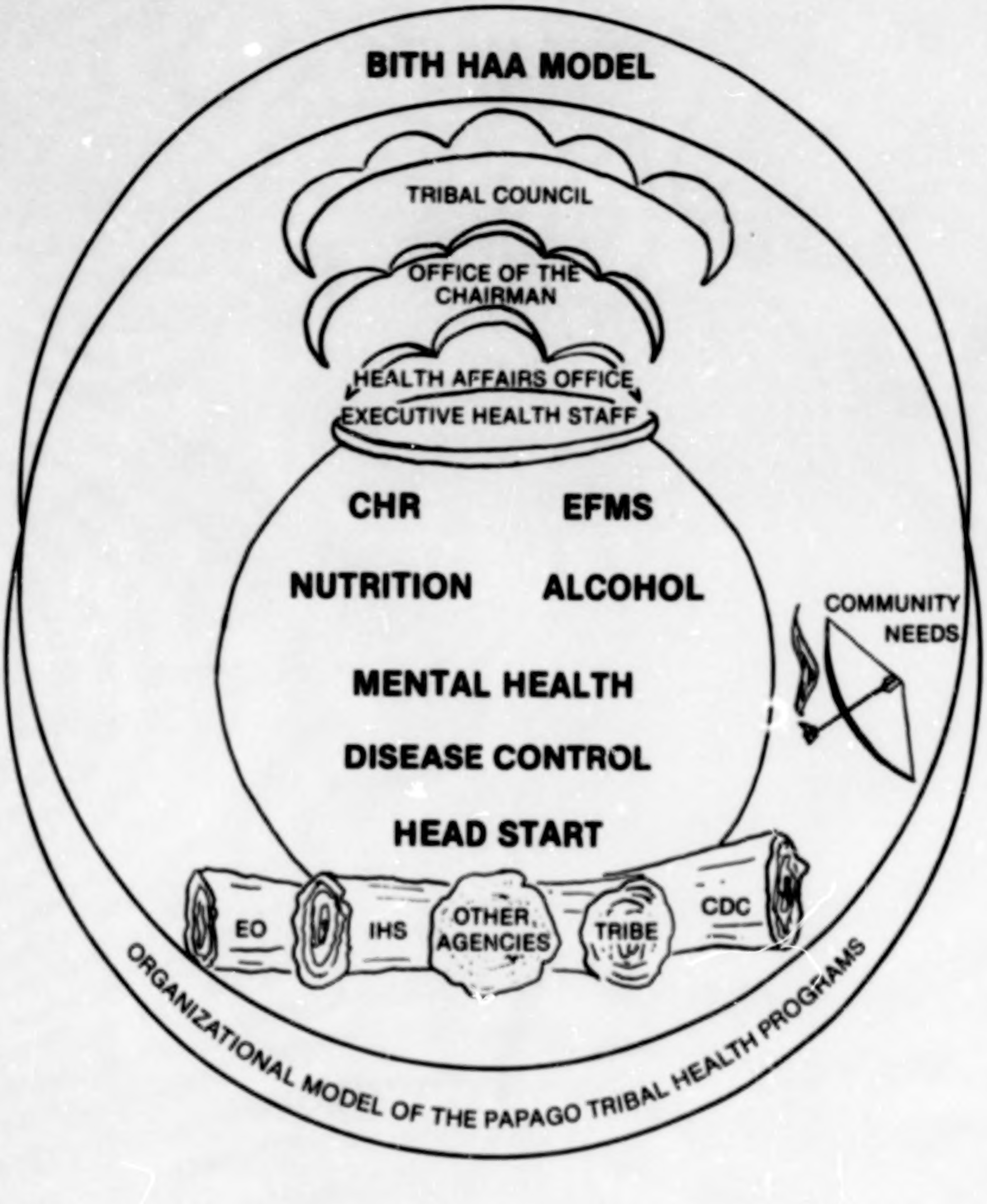

BITH HAA MODEL
TRIBAL COUNCIL
OFFICE OF THE CHAIRMAN
HEALTH AFFAIRS OFFICE
EXECUTIVE HEALTH STAFF
CHR
EFMS
NUTRITION
ALCOHOL
MENTAL HEALTH
DISEASE CONTROL
HEAD START
COMMUNITY NEEDS
EO
IHS
OTHER AGENCIES
TRIBE
CDC
ORGANIZATIONAL MODEL OF THE PAPAGO TRIBAL HEALTH PROGRAMS

Figure 13: The *Bith Haa* Model

coordination of all health presently associated with the Papago Tribe; and

WHEREAS, administrative support is needed so that proposed coordination be developed in the form that is constructive, productive and suited to Papagos,

NOW, THEREFORE, BE IT RESOLVED BY THE PAPAGO COUNCIL that it hereby creates and recognizes the Executive Health Staff under the Executive Officers of the Papago Council to act on behalf of the Tribe in initiating actions, formulating policy, examining health matters, managing, coordinating, administering and implementing Tribal health programs. The Executive Health Staff shall advise the Chairman of the Papago Council or, if necessary the Papago Council on health matters and make recommendations or take direct action on health issues that come to the attention of the Tribe.

The *Bith Haa* model reflects the basic goal of the Papago people which is "to live in harmony, as O'Odham, with the environment." The *Bith Haa* model allows all participants the fluidity and flexibility to merge in the appropriate manner to analyze problems and develop solutions which are most appropriate for the Papago. Choice of *Bith Haa*, the clay pot, was symbolic in several ways. First, it is a container wherein the interaction between the parts is imperative, and secondly, it is fragile, thus representing the delicate bond that holds the health services together. The blending inside the pot is essential for the successful outcome that reflects all activity within the pot.

The *Bith Haa* model (Figure 13) has the following components:

1. The pot holds essential ingredients (human resources) which are necessary for the development of any program or combination of programs.The ingredients of the pot are: the health staffs (sometimes listed under their program titles — CHR, Disease Control, Head Start, etc., as well as agencies or individuals which may be part of the pot (on an ad hoc basis); professional and technical personnel; medicine men; community members; and other types of community workers may also belong to the latter group. However, each component retains autonomy within its own program but is bounded with one another by a common goal.
2. The *mouth* of the pot represents the Executive Health Staff who are representatives of all of the programs in the *Bith Haa*.
3. The *first puff of steam* represents the Office of Health Affairs.

The later is not in steady operation but functions whenever an individual or group wants to present a specific idea to the members of the system or when a special joint activity is required (such as the STARPAHC project).

4. The *second puff* represents the Chairman of the Papago Council. He is the liaison between the Council and the Executive Health Staff.
5. The *third puff* represents the Papago Council which has control over all tribal programs and activities.
6. The *logs* under the *Bith Haa* stand for the tribal resources or monies from outside resources which are necessary for the sustenance of the process.
7. The *bow and match* illustrate the community's needs. The community is the bow that activates the match (needs) that lights the fuel and activates the process inside the pot.

As of 1971, i.e., prior to the establishment of STARPAHC, the Operational Health Programs in the Tribe were as follows:

1. The *Community Health Representatives* (CHR) Program was the first tribal health service. There were twenty-two CHRs and one CHR Director. Initially they functioned in a

health care and medical transport capacity, primarily as outreach health workers. The Tribe viewed them as change agents. Much of the CHRs' time was spent explaining the need for and use of health services to the people in the villages. Because of the volume of their travel, the CHRs often complained of running a taxi cab business, since much of their time was spent delivering medications and transporting people often for non-medical but needed services. With time and redefinition and clarification of their role to the people, the CHRs were able to spend more of their time treating common ailments, delivering emergency first-aid, teaching disease control to communities, and identifying what they saw as unmet needs.

2. The *Papago Nutrition Improvement Program* consisted of a staff of nine persons who concentrated on infant nutritional problems as well as on nutrition and consumer education. Other major program involvement was in commodity food demonstrations, food stamps coordination and follow-up, and co-ordination of services of other local health programs. The program was funded under a direct demonstration grant to the Tribe from the Public Health Service Center for Disease Control.

3. The *Papago Psychological Services* was established in 1969. Its purpose was to assist individuals in dealing with a variety of personal problems and crises. One of its primary concerns was to provide activities for young Papagos.

4. The *Papago Alcoholism Prevention Program* was funded by OEO in May, 1971. Its staff consisted of six persons who provided individual counseling and also conducted alcoholism education classes. They utilized the PHS Hospital, the Tribal Work Experience Program, Law and Order, and several off-reservation halfway houses. They also operate a half-way house on the reservation.

5. The *Papago Disease Control Program* was an extension of the earlier Otitis Media Program. This program also functions under the Executive Health Staff and is staffed by trained Papago people. Its main emphasis was on identifying and attacking endemic and epidemic diseases and their complications.

6. In addition to these programs the *Executive Health Staff* includes representatives from the Wise-Ones, a program for the Aged, Head Start and a Highway Safety Program. Recently, the Executive Health Staff was assigned responsibility to develop and operate a Children's Home on the reservation.

7. The *Papago Tribal Police System* was also vital to the health system because they often provide transportation to patients, they also provided assistance in emergency care.

The impact of the CHR and other health programs is reflected in the 1973 improved life span and infant mortality rates of the Papago Tribe. The major obstacles to quality health care, however, have continued to be the lack of communication and transportation to health care facilities. This applies especially to emergency situations in most parts of the reservation and to most care in the isolated western districts.

Communication to health facilities has been limited to a small number of telephones and short-wave radios. The 1970 Mountain Bell Directory for Tucson and the surrounding communities shows 200 lines for Sells, 9 for Santa Rosa and Gu Achi, 5 for Topawa, 5 for Covered Wells, 3 for Santa Rose Ranch, 2 for Ali Chukson, and one for each of the following widely scattered communities: San Miguel, Vaya Chin, Fresnal Canyon, Pisinimo, Choulic, Karwo, and Anegam. All lines are subject to failure during the violent summer storms. Most of the phones are located in government faciities.

There are several hindrances to transportation. Only 25 percent of the families own motor vehicles and there is no public transportation. The restriction this places on the use of medical facilities is substantial considering the fact that there are seventy-four villages spread across an area comparable in size to the state of Connecticut. Environmental factors also limit transportation; mountains provide formidable barriers in the construction of roads to connect villages; flashfloods damage the roads and the high temperatures in the desert put great stresses on motor vehicles and their occupants as well. These facts soon became evident to NASA when seeking the test and demonstraton site for STARPAHC. It was very apparent that accessibility to health facilities constituted a major problem for the Papago and the physical environment was a major contributor to this problem.

Involvement with STARPAHC

The first contact the Papago had with telemedicine was through the telemedicine project at the University of Arizona in Tucson in 1971. Funds for that project were provided by the former Office of Economic Opportunity (OEO) for the purpose of developing a plan for a telemedicine network to connect five of the nine reservations located throughout the state and with the Phoenix Indian Medical Center, as well as the University of Arizona Medical Center in Tucson. More details about this project are provided in Chapter Five of this report. What concerns us here is the connection of the Papagos to this project.

The Chairman of the Papago Executive Health Staff — who later was elected as the Chairman of the Tribal Council — served on the advisory committe of the designated tribal representatives established for the purpose of ensuring tribal input to the design of the network. Despite the fact that the University's telemedicine project was regional in nature and centered on referral functions, its basic concept was similar to the system later proposed by NASA. Hence, the Papago representatives had knowledge about telemedicine and had already developed a favorable attitude toward its potential efficiency prior to being approached by NASA about the possible use of the reservation as a test site. One of the major appeals of this concept was the anticipation that with telemedicine the people would be able to maintain their own life style while being provided a new capability to reach competent medical help through telecommunications. It also meant that the average Papago would not need to travel the usual long distances to the health center unless the trip was required by a serious medical problem.

The decision to travel whatever distances separated the patient from the health center, which in some instances is formidable indeed, would be made by the physician in consultation with the Community Health Medics (CHMs) who are physically present with the patient in the remote areas. Moreover, there was an expectation that such an arrangement would necessarily obviate the need for travel in the majority of cases when the need to see the physician was not serious.

This early exposure to the concept of telemedicine through an influential person in the tribe probably helped to nurture the receptivity of the tribe to the idea when NASA approached them with the AHSFU project. Nonetheless, there were other grounds for their receptivity to the idea, as will be clarified later.

In the spring of 1972, when NASA inquired informally about the feasibility of installing a telemedicine project on the reservation, the Papago had mixed attitudes. On the one hand, they were favorably impressed with its potential contribution to lessening the geographic barriers and increasing access to qualified medical service. They were well aware of the fact that some of their people had to be transported long distances by automobile or bus, 50 to 60 miles and often had to wait all day to receive medical attention. But, the concept was still novel, and they needed more information before reaching a definite conculsion about the desirability of this mode of health care delivery on the reservation. On the other hand, they were concerned and wary about starting a good thing and then dropping it for lack of funds, as happened with the University of Arizona and earlier BIA projects. Indeed, they were concerned about the source and continuity of the funding particularly if the new system were to live up to its promise. They realized that a self-limiting demonstration project may build expectations that cannot be met after the demonstration period is over. But, they were not ready to resign themselves to the idea that the white man "giveth and then taketh away" at will. In brief, their chief concern was what to do after people have received a valuable new service that became part of their life. Beyond that, they had some misgivings about the short duration of the demonstration, feeling that it was probably too short a period to learn anything worthwhile from it.

The basic explanations NASA gave about the proposed project were received with a strange equanimity that only a Papago can truly understand. The NASA official indicated to them that the federal government realized that the delivery of health services in remote areas here on earth could be improved by the use of space technology developed by NASA, and that the Papago were being considered as potential beneficiaries of such technology. The most appealing idea was that man was sent to the moon by the application of an advanced technology, and his medical needs were provided through advanced telecommunications. Some of this technology could be used on earth to improve health services in remote areas. Everything the NASA official explained to them seemed to fit an anticipation that someday this would happen. The older people of the tribe accepted the idea readily because they had predicted that something like this was going to happen, that something developed for outer space would be offered to the Papago people in order to help them. Exactly what the basis of these expectations were never became clear, and perhaps could not be truly appreciated by persons outside the tribe. However, predictions like this are not rare. The more common ones deal with immediate situations and few are long-term "forecasts." There was mention in the legends about the coming of the "white man" and the dire prediction that the Papago blood line would run dry in the future, probably as a consequence of an atomic explosion. Nonetheless, irrespective of their basis, these attitudes characterized the few who had such visions, and they do reveal their serious concerns and anticipations.

It was felt that unless the people wanted it, the project should not be brought into the reservation. The responsibility of reaching the people to explain the nature of the proposed project and to solicit their support for it was assumed by the Executive Health Staff. Of course, they knew that the Tribal Council would not approve the project until they were assured of popular support for the idea, particularly in the districts where it was to be installed. Yet, the members of the Executive Health Staff felt they had to know more about the proposed system before going to the people.

Arrangements were made, through the ORD/IHS, for the Executive Health Staff to visit the nationally-known telemedicine system at Logan Airport Medical Station in Boston. This fact-finding trip took place in June of 1972, and it gave the Papago their first close look at an operational telemedicine system. They tried to learn as much as possible about its operation during their visit, and they returned home with a favorable impression.

The most productive trip was made to NASA's Johnson Space Center in Houston in August in 1972, with officials from ORD/IHS accompanying the Papago group. It appears that whatever questions remained on the minds of the members of the Executive Health Staff were resolved during this visit, and the big push to get popular tribal support for the project

Figure 14: STARPAHC Relay Tower, Mt. Logan in Quijotoa Range, Pisinimo District, Papago Reservation

was on. Interestingly, the conculsions reached by the Executive Health Staff regarding the potential efficacy of the proposed system were not identical, even though the problem of accessibility (waiting time, convenience, distance to care) was on everyone's mind, Most of them shared the view that the Papago should benefit from increased access to care. They knew from their experiences that people tended not to go back for follow-up care or even keep initial appointments because of limited access. Some identified the problem of access in rather specific terms such as the care for the chronically ill on a continuous basis, care for complications of childbirth that could save many lives, and the provision of preventive prenatal and postnatal care when travel is especially difficult. The proposed project was favorably viewed to address these problems.

Beyond these basic considerations, there is yet another important factor that stems from Papago culture. The Papago have difficulty understanding and accepting the distinction that is made between the general practitioner and the specialist, and they fail to see that both are equally qualified providers. They tend to view the specialist as the "good" doctor who knows his business best and general practitioner as the doctor who knows less. Therefore, it is important to the Papago to be able to get at least a referral or consultation with the specialist. The most frequent complaint has been the continuous influx of new and young physicians who serve a term of duty at the service unit on the reservation and then leave. They often ask, "Why do they come over here and practice on us?" Telemedicine was perceived at least as partial remedy to that situation.

Their experience with the University's project convinced them that, if approved, the proposed funding for the regional network linking five reservations was going to be very deficient, but perhaps more importantly, they were not convinced that the nature or extent of Papago health problems were adequately understood, nor was the manner of handling these problems acceptable to the Papago. On the contrary, the NASA proposal not only contained adequate funding but the tribal involvement was more realistic. Hence, if it became necessary to make a choice between the University-sponsored telemedicine network and NASA's project, the Papago would have no difficulty making a choice. The point to be made here is that while they were interested in the University project, they were enthusiastic about NASAs' project.

The information compaign conducted by members of the Executive Health Staff was aimed at reaching the people in the villages. Public meetings were conducted in the target area — the Western districts — and the project was explained to the people and their questions were answered and their concerns aired in public. Some were concerned about the possibility of being shown on public television in Tucson or elsewhere in undesirable situations, such as being examined with private parts of their bodies exposed. This would violate a Papago sense of propriety. The most serious concern, however, was the influx of outsiders into the reservation who might not respect tribal traditions and desecrate sacred areas. Certain locations on the reservation have special significance as a ceremonial places and outsiders are strictly forbidden access to them. They wanted to be certain that no one would be allowed to trespass these areas. The location of the relay stations was first assumed to be objectionable because the engineers said it had to be the Sacred Mount Quijotoa.* It turned out they really meant Mount Logan closeby, and the problem was averted. See Figure 14 for an aerial view of Mount Logan and the STARPAHC relay tower. Other more practical

* Quijotoa is not only one of the highest elevation on the reservation land but is also viewed with special reverance as the seeding place for the clouds that bring rain.

questions had to do with the use of water for the Mobile Health Unit (MHU), that the personnel running the MHU do not just hook into anybody's water source without prior permission. Other utility problems were also discussed.

The role of the Medicine Men came up during these discussions, but this was not perceived to be a serious problem, since the Medicine Men has already accepted the idea of referring patients to the service unit and Anglo doctors. As explained earlier, the Papago see no conflict between Western medicine and ther own. Hence, the Medicine Men accepted the idea of telemedicine as part of "white man" medicine. Their acceptance, however, was conditional upon the respect of the Papago culture. Initially it was agreed that the Medicine Men could use the STARPAHC system if they wanted.*

Another interesting sidelight concerning this informational compaign and the review process by the Tribal Council pertains to the communication process. Because of the technical complexity of the telemedicine project, it often proved difficult for members of the Executive Health Staff to explain details of the project in the Papago language. There was no equivalent terminology in Papago to refer to many of the components of the system. The residents of the Western Districts are the most conservative on the reservation, and they routinely continue to use Papago language. The Tribal Council conducts all its business sessions in Papago.

As expected, the results of these information efforts expedited the approval process in the Tribal Council, concerns from its members about being pushed into a quick decision notwithstanding. Typical of the nature of decision-making among the Papago, an issue has to be clearly understood and accepted by everyone concerned before a final decision can be reached. Realizing NASA's need to reach a quick decision, and not wanting to lose their opportunity, the Tribal Council approved the project in principle, but their resolution was not enacted until after the Papago Reservation was selected as the test site. The announcement of the award was made on April 6, 1973 by the administrator of HSMHA. The Tribal Council enacted its Resolution No. 27-73 to jointly implement the project on May 4, 1973. However, prior to their resolution, the Papago stipulated that NASA would pay to have the equipment removed if so desired by the tribe. The Tribal Council adopted the following resolution:

WHEREAS, the Papago Council is concerned about improving and expanding the health care on the reservation and recognized the need to improve the present system of health care, and

WHEREAS, the telecommunications project to be conducted jointly by the Papago Tribe, Indian Health Service, and the National Aeronautics and Space Administration, hereby known as (NASA) is a unique effort to expand and extend medical services to the more isolated areas of the reservation by linkage with specialists at the Phoenix Indian Medical Center in Phoenix and/or the University Medical Center in Tucson, and

WHEREAS, the telecommunications project will attempt to improve the quality of health care and communications on the Papago Reservation by the installation and maintenance of modern communications equipment, including television, voice communication and other patient data such as pulse, heartbeat and temperature which will require the installation of communication towers on Quijotoa Mountains and Mt. Lemmon and access to the use of the communications towers on Kitt Peak or the possible installation of such towers on Kitt Peak, and

---

*Or as one Papago laughingly commented. "They have their own telecommunications system and it's better."

WHEREAS, communications equipment will be installed at the Sells Hospital and Santa Rosa Clinic and a fully equipped mobile clinic van to be used throughout various areas of the Papago Reservation with the capacity to communicate with Sells Hospital or Santa Rosa Clinic provided that:

1. The Papago Council through the Executive Health Staff will be involved in all phases of the planning, development and operation of the telecommunication project and will keep the Papago Council informed throughout the project by reporting to them at regular intervals.
2. The telecommunications linkage with Phoenix Indian Medical Center and/or the University Medical Center in Tucson (for special consultation) be established during the project.
3. Whenever possible Papagos will be trained and employed in the technical as well as non-technical areas of the telecommunications project.
4. That all possible measures will be taken to maintain patient dignity, privacy and confidentiality of patient information.

THEREFORE BE IT RESOLVED, that the Papago Council on the 4th day of May, 1973 by a vote of 19 for, 0 against, 1 not voting, and 2 absent during a meeting at which a quorum was present, pursuant to authority vested in The Papago Council by Article V Section 2 (a), (e), (f) and (h) and Section 3 (a) of the Constitution and Bylaws of the Papago Tribe of Arizona ratified by the tribe on December 12, 1936 and approved by the Secretary of the Interior on January 6, 1937 (48 Stat. 984) pursuant to Section 16 of the Act of June 18, 1934. Said resolution is effective as of the date of its approval by the Superintendent of the Papago Agency and is not subject to review by the Secretary of the Interior.

From the application stage and throughout the negotiation process, as well as the design of the system, the Papago asserted their role as an equal partner in their project. They quickly realized the technical complexity of the project, and they were well aware of their own limitations in understanding everything. However, technical or not, they made it quite clear that they wanted to be fully involved. They were not sure that the emphasis on the "team" approach was actually intended to include them. However, it became evident to them after several meetings, and after their contribution to the design of the project was acknowledged by the team members, that they were accepted as members of the team.

The nature of the Papago involvement with the planning, development, and operation of the project will be explained in Chapter Five. It will suffice here to point out some of the signifigant contributions made by the Papago to the design and operation of the project. These can be summarized as follows:

1. Black and white TV monitor to permit the patients to view and talk with the Sells staff (physicians) were added to the Mobile Unit and Santa Rosa Clinic.

2. Routes and stops for the Mobile Health Unit were determined, including the decision to concentrate on the remote underserved western districts.

3. The Mobile Health Unit design was changed to ensure patient privacy and acceptability, in particular the direct entrance from the outside to the examination room was changed to the reception area.

4. The Mobile Health Unit support requirements were defined in terms of logistic support and staffing.

5. The affected villages, districts, and the Tribal Council were briefed on the system and its proposed impact and their endorsements were received.

6. A search for Papago staff to maintain and operate the equipment was successfully concluded with the hiring of a technician to coordinate the technical aspects of the system.

7. A slow-scan system was added to link the service unit to the Phoenix Indian Medical Center for specialist consultation.

8. The name of the project was changed from AHSFU (a purely NASA project) to STARPAHC reflecting the active involvement of the Papago in the system and the existence of an advanced health care system prior to the introduction of telemedicine.

There were several other ways in which the Papago had impact on the project, including the following:

1. All publicity releases, photos, etc., had to be reviewed and authorized by the tribe.

2. The fence around the microwave tower and related buildings was painted to match the natural surroundings.

3. The land for the microwave station was leased by U.S.P.H.S. from the Papago for the STARPAHC project only.

4. Road construction was limited to the necessary connections which they felt would not pressure the natural terrain.

5. The Tribal Council maintained control over who could visit the reservation and on what days.

6. Members of the Executive Health Staff provided orientation for LMSC employees and others coming to the reservation, featuring information on Papago lifestyle, customs, history, and regulations, as well as health and safety in the desert.

Summary and Conclusions

The Papago history and culture presented here serve as background to the community that accepted the STARPAHC project. These highlights reveal the culture of the Desert People, deeply entrenched in the land and environment in which they have lived for thousands of years. Though the Papago have developed a unique culture of their own, they share with other Indian cultures a deep sense of identification with nature. They hold sacred views about the inviolability of the environment.

While the Papago have tried to hold on to their cultural patterns and to maintain their traditional way of life, they have also demonstrated a willingness to accept innovations as long as they did not disturb the principle of living in harmony with nature. Indeed, the Papago perhaps learning well the lessons taught by tradition and their intimate relationship with the environment, tend to adopt those innovations which are seen to contribute to the quality of life of their people, yet do not threaten what they believe to be most sacred.

Before STARPAHC came to the reservation, the Papago, in co-operation with the Office of Research and Development of the Indian Health Service, had developed an effective health system, with various specialized programs focused on personal and environmental health needs such as disease control, nutrition, alcoholism, and mental health. The Executive Health Staff was created for the purpose of managing these programs and for establishing an integrated health program for the tribe. The fact of their advanced health care system was symbolized by the change in the name of the project from AHSFU to STARPAHC. Nonetheless, because of unique aspects of the Papago culture the coming of

STARPAHC to the reservation appeared as a natural and logical step in a evolutionary process of reapproachment with the dominant Western culture.

The administrative style of the Papago can be characterized as participatory democracy governed by two principles, local representation and consensual agreement. Because of the traditional emphasis on local village autonomy, representation of local interests is emphasized and this is reflected in the composition of the Tribal Council. Decisions are arrived at after long deliberations, typically reflecting consensus rather than simple majority.

The coming of STARPAHC to the reservation was facilitated by advance preparation by the members of the Executive Health Staff. After preparing their homework, learning all they could about telemedicine, they conducted a local educational campaign to assure its acceptance and to determine that it would be acceptable to the people in the service area and they presented their case to the Tribal Council. The Council was assured that the cutural imperatives of the Papago would be respected and observed by NASA and LMSC. Moreover, when the project moved from the proposal stage to planning, design, and implementation, members of the Executive Health Staff chose to play an active role in the entire process, thereby ensuring that the best interests of their people are served.

From the Papago point of view, the major issue never had anything to do with how the project came to the reservation, but what would happen if it were taken away after the people grew accustomed to having its services nearer to their homes. The problems of accessibility in the remote areas have been relatively met by the Mobile Health Unit. It does not matter to the Papago that some expensive equipment components are taken away. What does matter is that people will not be deprived of a vital service after it has become part of their lives.

Figure 15: Vaya Chin Village Served by STARPHAC

78

Figure 16: Pisinimo Village, Site of Mobile Health Unit Stop

TABLE OF CONTENTS

		Page	
List of Figures and Illustrations		ii	1/A5
Preface		iii	1/A6
Chapter One	General Background and Rationale of STARPAHC	1	1/A7
Chapter Two	Genesis of STARPAHC at NASA	17	1/C1
Chapter Three	The Indian Health Service	33	1/D3
Chapter Four	The Papago People	55	1/E13
Chapter Five	System Design and Evaluation	81	2/A3
Chapter Six	Summary and Conclusions	101	2/B10
Appendix	Publications about STARPAHC	ai	2/C8

BLANK PAGE

BLANK PAGE

Chapter Five
SYSTEM DESIGN AND EVALUATION

Introduction

The emphasis in this chapter is placed on the convergence of the participants, and the basic process that was implemented to assure their equal and responsible participation in the planning, establishing of requirements, design, implementation and evaluation activities.

The historical accounts of the interagency agreements and activities are presented, together with a contrast in the style of program development, as carried out by NASA and DHEW. Since there are significant differences between the objectives of the two agencies, one focusing heavily on technology and precision, the other on a variety of human service needs, it is of considerable interest to contrast the styles of activity of the two agencies. Perhaps, each can learn from the other about complexities in the human factor and in the technology that need to be appreciated more and more. Added to this agency mix was the Papago Tribe. Their style, objectives and participation were paramount, since the system was being built to serve Papago people on Papago land. The development of the STARPAHC program blending the styles of all of these constituents and the methodology employed may be instructive to future health and telemedical system designs.

The Participants

Because of NASA's central role in the development of telemedicine and the sponsorship of STARPAHC, it is easy to lose sight of the joint efforts involved in the design and evaluation of this project. That is why it is crucial to provide a rather complete picture of the design and evaluation processes keeping NASA's role in proper perspective.

Typical of its approach to important missions, NASA developed its concept of telemedicine in explicit detail prior to the procurement of a contractor to design, manufacture and assemble the appropriate technology for its implementation. The concept development also occurred before site selection and the involvement of the IHS and the Papago. Hence, an explanation of NASA's approach is the logical starting point in describing this joint venture.

The Participating Organizations

By necessity, NASA has to reduce uncertainty in its missions to minimal tolerable levels. This means that all known variables that affect performance have to be explicitly defined and accurately measured, and all errors or discrepancies are corrected and certified and alternatives established and evaluated. For instance, when a mission such as landing man on the moon was adopted, its organization moved methodically toward the achievement of that mission. From the design requirements to the actual design specifications, the analysis of operational problems, shakedown test, mission simulations and certification, all the predictable elements that could be controlled or manipulated were identified and carefully assessed. All significant problem areas were resolved before final certification. This is characteristic of NASA's managerial approach in meeting its objectives. Its approach to the design of STARPAHC was no exception, even though it had been accustomed to the design of man/machine systems that are amenable to precise measurement, rather than dealing with the complexity of cultural traits and preferences. This is to say, NASA's primary concern is with the design of technologies that meet specific operational requirements. The extent of its dealing with individual attitudes or cultural attributes is limited. In brief, to meet its space missions, NASA has developed a thorough systems design, test and certification process that is meticulously followed in order to assure the proper performance of each part in its technologic systems as well as the system as a whole. Astronauts were treated in almost the same manner, but only in the sense that their performance was assured as far as possible through elaborate training, testing, and simulation. In cases of both man and machine, the potential for predictable failure is minimized.

Further, the astronauts are closely involved in the development of the system they are to operate. Another important fact of NASA's approach is that their systems are developed *de novo* for a mission or family of missions. Human service systems are, of course, in place and operating and are not necessarily designed anew for each mission or mission emphasis or technologic capability change.

Nevertheless, it is precisely this design, test and certification process that might be needed in a wider implementation of telemedicine or other technologically-based innovations in medical care. Indeed, this modified aerospace systems engineering process may also prove valuable in programmatic innovations in the medical care field without necessarily involving high technology. It is more than the traditional systems approach, and it involves greater specificity of problem definition, a detailed analysis of performance of units within the system, and an exacting testing and certification procedure. Knowing the potential for and probabilities of defined failures, the risk factors and impact associated with these, the alternatives and priorities are all vital to a precision systems design engineering process.

The development of the STARPAHC project can best be understood in light of this typical pattern, even though NASA occasionally found itself in the unaccustomed position of having to justify its specific objectives and to alter its plan to accommodate the preferences and needs of either ORD, the Papago, or stringent budgetary constraints. When one designs equipment, the basic question is how to design the equipment to perform its designated functions. All man-machine interactions are determined on the basis of performance, proficiency, reliability and often costs, and these contain all the variables required for analyzing the tradeoffs. But when people's preferences are taken into account the design becomes more complex. In telemedical or other socio-technical systems preferences, culture, provider, and changing consumer direction become essential variables in system performance, acceptance and impact.

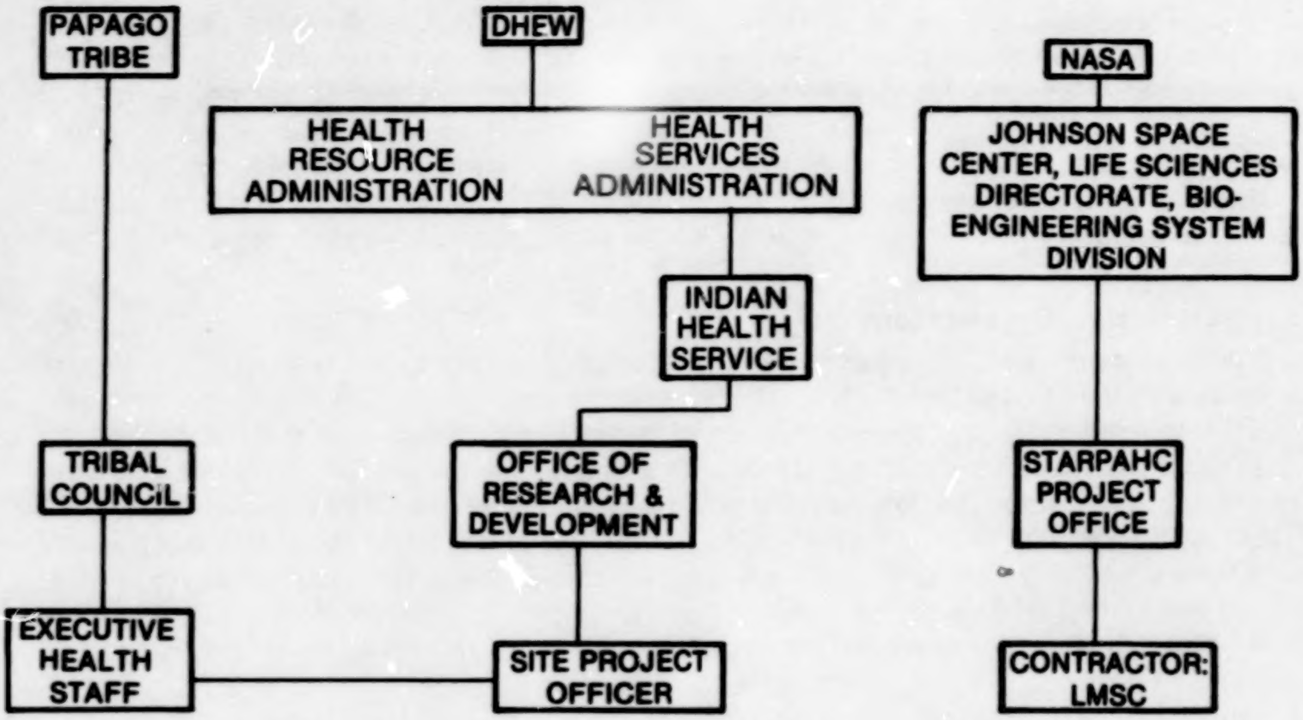
The clearest and most complete statement of NASA's conception of this project as a part of a larger regionalized plan covering the entire United States was contained in its report to the President's Domestic Council (1972), reviewed earlier in Chapter Two. For a successful research and demonstration project, the starting point was the definition of optimal conditions including an environment on earth that paralleled some critical variable of the environment of outer space, i.e., a population that (a.) is located an appreciable distance away from the nearest physician; (b.) can be served by non-M.D. providers; (c.) is willing to participate in the project; and (d.) it was hoped, be able to continue the project beyond the demonstration phase.

The joint NASA/DHEW sponsorship of the IMBLMS demonstration project was NASA's idea. DHEW's role in the site selection process, medical and logistic support, and medical evaluation were figured to be prominent, and were. If the full national plan were to be adopted, it would be impossible without DHEW partnership. As events unraveled, once the site was selected, DHEW's initial interest for the project dwindled, short of the continuing and active involvement of the Office of Research and Development of the Indian Health

Service. This latter group did not diminish its active participation in the design, implementation and evaluation of the project. On the contrary, as true project team participants, they carried a heavy load in all project activities and provided logistic, manpower, and technical assistance. They frequently served as translators among engineering, medical, Papago personnel and the ever interested press community. As will be seen later, the medical evaluation rested exclusively on their shoulders, with the hardware and operational technical support evaluations remaining a NASA/LMSC evaluation responsibility.

The Participating Organizations

After site selection, three participating organizations were to be involved in the design and evaluation of this project: NASA, DHEW, and the Papago. Each of these organizations had designated units or sub-organizations that were responsible for the completion of specific tasks. NASA's sub-organizations that were responsible for the completion of specific tasks included the Johnson Space Center, Life Sciences Directorate, and Bioengineering Systems Division, which includes Lockheed as its prime technical contractor. DHEW had the Health Resources Administration and the Office of Research and Development of the Indian Health Service. Finally, the Papago Tribal Council had its Executive Health Staff. The following diagram shows the participating organizations and their sub-organizations. Also included in the diagram is the identification of the administrative office in each organization that had direct responsibility for STARPAHC.


PAPAGO TRIBE
DHEW
NASA
HEALTH RESOURCE ADMINISTRATION
HEALTH SERVICES ADMINISTRATION
JOHNSON SPACE CENTER, LIFE SCIENCES DIRECTORATE, BIO-ENGINEERING SYSTEM DIVISION
INDIAN HEALTH SERVICE
TRIBAL COUNCIL
OFFICE OF RESEARCH & DEVELOPMENT
STARPAHC PROJECT OFFICE
EXECUTIVE HEALTH STAFF
SITE PROJECT OFFICER
CONTRACTOR: LMSC

The initial statement of responsibilities of each of these participating organizations were defined as follows:

NASA/JSC Program Management

1. Program coordination, planning, and budgeting
2. Technical direction and control
3. Interagency and contractor coordination
4. Program data and documentation coordination
5. Government furnished equipment

LMSC, Program Office: Prime Contractor to NASA/JSC

1. System definition and design
2. System assembly, installation, checkout, and personnel technical training
3. Field system operations, maintenance, system evaluation (hardware)
4. Computer programming

DHEW/IHS: Program Management Team Member

1. Program and Contractor Guidance and Coordination
2. Government Furnished Equipment and Facilities, Personnel and Services
3. Health Information System
4. Clinical and Medical Care Evaluation
5. Coordination with Papago Tribal Council

It is interesting to note the *exact* role of the Papago was not clearly specified during the developmental phases. The IHS view was that the tribe should be involved in all aspects of design and development, but that it would be inappropriate to specify, for the Papago, what their exact role should be. This would and did develop. One function was clear from the outset, nothing could happen on the reservation without Papago approval. Other than including members of the Executive Health Staff to attend meetings and render opinions, there was no clear definition of what constitutes a proper role for the Papago representatives other than broadly represent the interests of the Papago people. Indeed, in the major brochure that NASA distributed in August of 1974 (JSC-0916), there was no reference to the role of the Papago in the text, and in the statement that specified the responsibilities of the participating organizations, the Papago responsibilities were omitted entirely. This occurred despite the fact that the organizational chart feature the Papago in the tripartite managerial groups involved in the project. Conversely, LMSC's role was explicitly defined. The absence of any mention of Papago responsibilities in the organizational chart reflected NASA's view that the Indian Health Service was to act as the intermediary between the Papago, NASA, and LMSC.

In the STARPAHC Systems Report of October 30, 1977, the Papago role was specified as:

- Appropriate legislation, e.g., Tribal Council resolutions permitting the project on the reservation, the relay tower installation, etc.
- Community cooperation for MHU operation, e.g., allocating space for a parking pad in the villages, water, and electric access where appropriate.
- Video health education, e.g., support for programs in the villages.

The Papago representatives interpreted these initial actions by the governmental agencies as resulting, at least in part, from a paternalistic attitude on the part of both NASA and the Indian Health Service. They felt that during the technical design sessions there was a paternalistic attempt by the agencies to shield them from the potential embarrassment of having to deal with highly technical material. To show that this concern by NASA and IHS was unwarranted, members of the Executive Council subsequently pointed to the specific contribution they had made to the technical design of the project, such as certain aspects of design of the Mobile Health Unit, return video transmission to the patient, etc. While they recognized that there were many technical aspects they did not understand, they had a stake in the system that was to be installed on their reservation, and they had a job of seeing to it that the interests of their people were best served. As a consequence, the Papago representatives felt that Indian input was needed in all aspects of the planning and design of the project, and this was accepted by all as a vital asset.

The Relationship Between NASA and DHEW

NASA's dialogue with DHEW regarding the IMBLMS/AHSFU project began at a meeting held in Washington, D.C. under the auspices of the National Academy of Engineering in January of 1971. A joint committee on the Interplay of Engineering with Biology and Medicine including key representatives from both NASA and DHEW met at the Academy and the primary topic of discussion was IMBLMS. The negotiations that followed the meeting resulted in an agreement between these two agencies to work together in a cooperative project whereby DHEW would help in site selection, provide trained health personnel and associated medical facilities and services, and NASA would develop the systems technology and provide for the project's operation and maintenance.

NASA asked for the composition of two committees to effectuate the project through establishing: (a.) a Site Working Group that would consist of three persons designated by DHEW and by NASA under the chairmanship of a DHEW designee: and (b.) a Site Selection Board co-chaired by the Administrator of the Health Service and Mental Health Administration (HSMHA), NASA's Director for Life Sciences and one representative from each agency, a total of four persons.

This site selection process was discussed earlier and hence there is no need to repeat that story here. However, certain aspects of that process may help to clarify the nature of the working relationship between these two agencies, and more importantly, shed some light on the unexpected withdrawal of support from the medical evaluation by the National Center for Health Services Research.

After the reorganization of the Public Health Service which eliminated HSMHA and created the Health Services Administration (HSA) (in which IHS was located) and the Health Resources Administration (HRA) and the establishment of the National Center for Health Services Research in HRA; there were new faces at the helm both at NASA and DHEW. The final agreement was worked out between the Deputy NASA Director for Life Sciences and the Assistant Secretary for Health; a significant change was DHEW's withdrawal of support from the medical care evaluation. However, DHEW agreed to deliver "medical evaluation criteria" which were never defined nor delivered. IHS did, however, develop and implement an evaluation method.

Hence, in order to preserve the alliance necessary for the successful completion of the project, NASA accepted the new terms requested by DHEW which were tentamount to a withdrawal from the previous agreement. It soon became obvious that while NASA, the Indian Health Service, and the Papago were able to sustain their commitment, and being a contractor, Lockheed did as it was committed, DHEW reduced its commitment to the least possible level. DHEW withdrew its agreement to support the medical evaluation, and the National Center for the Health Services Research retracted support for a comprehensive evaluation of the project, all this to be explained subsequently in this chapter.

The following is the text of the agreement between DHEW and NASA on April 15, 1974.

> In compliance with the DHEW/NASA jointly approved IMBLMS Site Selection Plan, the following is the agreement between DHEW and NASA for the IMBLMS/STARPAHC Project, involving DHEW/Indian Health Service (IHS), NASA/Johnson Space Center (JSC), and the NASA contractor, Lockheed Missiles and Space Company (LMSC).
>
> 1. The NASA contract to LMSC is estimated to cost $3.352 million over a period of four years. Under this contract, NASA will provide for IMBLMS/STARPAHC program definition and system design during the first twelve months, and system assembly, testing, installation, and check-out on site during the second twelve months.
> 2. NASA/JSC (Chief, IMBLMS Program Office) shall be responsible for directing all technical aspects of the contractor's activities, in accordance with established NASA standards and procedures for monitoring systems contractors.
> 3. DHEW shall participate in all program requirements and design reviews and actively support the definition and design activities. DHEW/Indian Health Service (IHS) Office of Research and Development shall negotiate with and coordinate NASA/LMSC plans and activities with the selected community, the Papago Indians, to define and document the points of contact and responsibility for test operations, future planning, and advice and consultation during the design, assembly, and installation phases of the project. DHEW shall coordinate all community/contractor medical plans and relationships.
> 4. The functions described above shall be discharged by the DHEW IMBLMS/STARPAHC Project Manager, who will interface with the NASA/JSC Chief, IMBLMS Program Office.

The day-to-day STARPAHC medical and administrative operations at the Papago Reservation shall be coordinated and supervised by a DHEW STARPAHC on-site project officer, who will interface with the DHEW/STARPAHC Project Manager and the NASA/JSC Chief, IMBLMS Program Office.

5. NASA/LMSC shall develop the criteria to be used in the engineering evaluation of the STARPAHC system. DHEW shall develop the criteria to be used in the medical evaluation of the system.
6. NASA/LMSC shall provide a technical system familiarization and training program for IHS medical and paramedical personnel. IHS shall provide medical training for the STARPAHC paramedical personnel (Community Medics, CHM).
7. Space in existing Indian Health Service (IHS) facilities, namely space for the Support Control Center in the PHS hospital at Sells, Arizona and space for the local Health Services Center in the PHS clinic at Santa Rosa, Arizona, will be made available for STARPAHC at no cost to LMSC or NASA.
8. Existing IHS medical equipment at Sells and Santa Rosa will be available for use in STARPAHC at no cost to LMSC or NASA.

   Expendable medical supplies will be provided by IHS to support two years of STARPAHC operations.
9. The IHS Health Information System (HIS) and associated hardware and software will be available to support and interface with the IMBLMS/STARPAHC data management system.
10. NASA/LMSC shall be responsible for engineering operations, system modifications and updates, and system maintenance and repair, during two years of NASA funded operations. LMSC shall provide for on-site personnel to include a Base Manager, two System Operators/Maintenance Technicians, a Programmer (six months), and a Maintenance Technician.
11. DHEW (IHS) shall be responsible for all aspects of STARPAHC medical operations. IHS shall provide the medical and paramedical personnel required (Physicians, Nurses, Physician's Assistant, Community Health Medics), and other administrative and clerical support personnel as required, to staff the various elements of STARPAHC during the two year operational test period.
12. In accordance with the jointly approved IMBLMS Site Selection criteria, and the site proposal submitted by IHS/ORD and the Papago Tribe, it is expected that IHS will continue the operation of cost effective elements of the STARPAHC system following completion of the initial two year operational test. To facilitate this transition, LMSC is being licensed to operate STARPAHC telecommunications equipment in government allocated frequency bands, in anticipation of DHEW applying for authorization to operate on the same frequencies following the completion of the two year operational test period.
13. NASA shall provide for the engineering evaluation of the STARPAHC systems operation.

Their respective roles were specified as follows:

NASA (and/or NASA Contractor)	DHEW
Support Site Selection Activities	Site Selection
Program Definition, System Design	Support Program Definition System Design
Assemble and Test System	Negotiating and Coordinating All Plans and Activities with Papagos
Installation and Check-out on Site	Provide Facilities, Medical Equipment, and Other Government Furnished Equipment and Expendable Supplies, Provide Access to Health Information
System Familarization/Training for Medical Personnel	Medical Training of Paramedics
Develop Engineering Evaluation Criteria	Develop Medical Evaluation Criteria
Responsibility for Engineering Operations, Systems, Modification/ Updates, System Maintenance and Repair	Responsibility for All Aspects of Medical Operations
Provide Personnel On-Site: Base Manager, System Operators, Communications/Maintenance Technician, Computer Programmer	Provide Personnel On-Site: STARPAHC Site Project Officer, Physician, Community Health Medics, Administrative and Clerical Personnel
Responsible for Two Years of Operation	Support and Continue to Operate Cost Effective Elements of System
Perform Engineering Evaluation and Medical Evaluation for Space Flight	

The application for consideration of the Papago Indian Reservation as the demonstration and test site was made by the Director of ORD/IHS and the Chairman of the Papago Tribe on November 27, 1972. Receipt of the application was acknowledged by the Administrator of HSMHA, who also arranged for a site visit January 9-10, 1973. The entire process from application to award took five months. The announcements of the award of a project site was made by the Secretary of DHEW on April 17, 1973. The Papago Indian Reservation was selected as the site for operational testing of a system "to improve medical care in space and remote earth locations." This was followed later in the year by a two-day planning meeting in

Tucson on April 26-27 to discuss the organizational relationships and the design and development process. NASA/JSC, IHS, HRA, and Papago Tribal members of the Executive Health Staff attended. At that meeting and the Preliminary Requirements Review (PRR) meeting in May, the Preliminary Design Review (PDR) meeting in June, and the Critical Design Review (CDR) meeting in August, (to be discussed later) ORD emphasized to HSMHA representatives the need to establish requirements for the evaluation plan early to assure that required baseline data would be collected during STARPAHC design prior to installation.

In September, 1973, a committee consisting of several officials from the Office of the Undersecretary for Health of DHEW and Health Resources Administration visited the Indian Health Service in Tucson for the purpose of developing an evaluation plan for STARPAHC. Representatives from the University of Arizona, College of Medicine, were invited to attend. Also, since ORD had been asked by the U of A to help in the design of the evaluation of their proposed system, the U of A was most anxious to include the IHS Health Information System in their design.

Because of the University's previous work in telemedicine, specifically in the proposed design for a health services communications network linking five Indian reservations, they were called upon to participate in the evaluation effort. The part played by the University of Arizona, though short-lived, was important since it probably provided some basis for ORD to develop its own evaluation plan. The following is a brief review of the University's part.

From January, 1972 to June 1973, the University of Arizona conducted a feasibility study of a network to link five reservations in Arizona. This work was supported by the Office of Economic Opportunity (OEO). The primary objectives of that project were twofold: (1.) "to apply advanced communications technology to the problems of comprehensive health care delivery in rural, geographically dispersed areas," and (2.) "to develop an economically sound, technically feasible telemedicine model capable of improving health services delivery in all classes of rural or isolated communities." The primary activities of the project were confined to demonstrating the feasibility of telemedicine in the state.

The Indian Health Service, Office of Research and Development (IHS/ORD), was involved in this project in two ways: (1.) The Director of the IHS/ORD in Tucson as well as the Chairman of the Executive Health Staff of the Papago were involved as members of the project's technical advisory board and project advisory committee, respectively; (2.) The Health Information System developed by the IHS/ORD was to be used by the telemedicine network. Subsequently, the Office of Economic Opportunity was discontinued, and the University demonstrated the feasibility of constructing the proposed network, however, no further action was taken. A new opportunity was presented to the University when the STARPAHC project evolved and was in need of evaluation. The point to be made here is that the University of Arizona had an active interest in telemedicine and it could not bring its own program to fruition, despite a carefully developed plan for a regional program.

Following the planning session that was held in Tucson in September of 1973, attended by University faculty, representatives from Indian Health Service and representatives from DHEW, the Health Care Technology Division, Bureau of Health Services Research and Evaluation (DHEW), issued a sole source Request for Contract (RFC, No. HRA-106 HSRE) for the University of Arizona to conduct the evaluation of STARPAHC with $400,000 budget for 40 months. This RFC was based on an evaluation design previously developed by the University. It was natural for the University to want to pursue this new opportunity since they had already invested in an evaluation plan that never saw the light of day. ORD/IHS had contributed significantly to this evaluation plan as a result of their participation on the technical advisory board.

The choice of the University as a sole source was justified on the following basis:

1. The geographic proximity of the University of Arizona and its close working relationship with Papago and the IHS, especially its involvement in the Community Health Medic (CHM) training program evaluation;

2. The University's previous contract work with OEO to develop a design and evaluation methodology for the Arizona Telemedicine Network;

3. An expansion of the STARPAHC project within the state of Arizona, if deemed desirable, could be readily effected by the University on the basis of its previous work with the tribal councils of the Indian tribes and the IHS—such rapport was perceived as crucial to the success of the expansion of this project in Arizona; and

4. Evidence of the University's ability to deal with the evaluation task was submitted to the Bureau of Health Services Research and Evaluation in the form of its proposed plan for the evaluation of the OEO sponsored project. The Bureau indicated its satisfaction with the quality of the original proposal and the demonstrated competence of project personnel.

When the Request For Contract (RFC) was issued, everyone concerned from NASA, IHS and the Health Care Technology Division of HRA was assured that its approval by superiors would be forthcoming, and no one doubted either the merits of the proposal or the necessity of following through to complete the evaluation. But all this activity was brought to a halt when the RFC was blocked at the higher levels of DHEW.

There was an explicit acknowledgement in this Request for Proposal of DHEW's prior commitment for the support of the medical evaluation of STARPAHC. The terms of this commitment were spelled out in the first Memorandum of Agreement between the DHEW and NASA (1973). However, the support was changed from an initial budget of $37,000 to $400,000. The original budgeting of all operations and their sources of funding are presented on the following table:

Activity	Source		
	NASA	IHS	DHEW
Design, Manufacture, and Technical Testing of Project (LMSC contract)	3,352,000		
Space for Control Support Center* and Local Health Services Center		75,000	
Existing Medical Equipment*		138,000	
Expendable Medical Supplies		130,000	
Physicians, Nurses, Physician Assistants, and other paramedical personnel, engineers, technicians and bookkeeping personnel		525,000	
Evaluation of Medical Operations			37,000
	$3,352,000	$868,000	$37,000

GRAND TOTAL: $4,257,000

*Explained as a cost savings for NASA.

It must have become painfully obvious to the people in DHEW who dealt with this project that the original allocation of $37,000 was ridiculously insufficient to conduct a comprehensive medical evaluation of STARPAHC. The new RFC that was developed by the Health Care Technology Division of the Bureau of Health Services Research and Evaluation, had it not been short-lived, demonstrated a good understanding not only of the nature of researchable problems and the types of evaluation likely to yield meaningful results but also a knowledge of the current costs. Hence, this RFC had an allocation of $400,000 for a period of 40 months, which would have brought the total estimated cost of the STARPAHC project to approximately five million dollars for a period of approximately four years.

The Evaluation Design

Results of the evaluation activities have been reported in separate documents. The discussion of evaluations here will be limited to the evolution of the evaluation plan and the nature of the division of labor between ORD and LMSC in this area. It should be repeated here that ORD had not originally intended to be directly involved in any evaluation, since it was the direct provider of care on the reservation. The plan was to solicit an organization external to IHS, to perform the evaluation thereby assuring greater objectivity. But, due to lack of funds, the ORD decided to undertake the evaluation on its own.

There were two types of evaluations conducted simultaneously but with different objectives. The technical evaluation of hardware and software systems was performed by LMSC as part of its contractual arrangement with NASA. Its primary focus was the technical performance of the system and each of its component parts. Though crucial to overall objectives of the project and to NASA's space programs, this aspect of the evaluation is of limited interest to health professionals whose primary concern in evaluation is not so much the specific capability of various pieces of equipment but the impact of the system as a whole on the users and providers of care. Therefore, the technical evaluation performed by LMSC will not be discussed here*. The second type of evaluation was concerned with the system of delivery and its acceptance by the providers and users. The Papago themselves assumed responsibility for investigating patient reaction to the STARPAHC system, and ORD assumed the clinical evaluation, the study of provider acceptance, and the assessment of impact on health status. The medical evaluation plan promised in the DHEW/NASA Memorandum of Agreement was not delivered.

The ORD developed a comprehensive evaluation scheme on the basis of the overall design it had adopted for all its research and developmental functions. This design consists of a bimodal matrix that identifes six major functions of a health care delivery system on the vertical axis and several evaluation specifications and requirements on the horizontal axis. The basic rationale is that all the possible activities undertaken in research and development can be classified as supporting one or more of these six functions. Given the objectives of STARPAHC, the questions to be answered for each function were: What are the expected impacts of STARPAHC upon the current implementation of each function of the delivery system? What information sources are there to measure this impact? What will be the study design to measure or describe this impact? What resources will be required to implement the study? Finally, what is the feasibility of the study and is there a plan developed for the conduct of the study? In a somewhat simplified form, the following matrix shows the major parts of this design:

---

*These are presented in "STARPAHC Systems Report," and is available from the NASA Technical Library, Johnson Space Center, Houston, Texas.

MAJOR FUNCTIONS	Evaluation Objectives	Expected Impact	Information Sources	Study Design Methods	Resources Requirements	Feasibility & Plan
1. Planning						
2. Operations						
Administration						
Health Care						
Community Services						
3. Standards						
4. Monitoring						
5. Evaluation						
6. Resource Acquisition and Modification						

It was further recognized that while the matrix was meant to be exhaustive of functions and requirements, it should have a mechanism for curtailing parts that are, for one reason or the other, not feasible. Thus, some of the cells will be identified as infeasible and will be excluded from the evaluation plan. The reasons for their inclusion in the master plan and their subsequent exclusion from the implemented plan are clarity and comprehensiveness. Because of this process, it is always clear which parts are in and which parts are out, and why.

The various limitations of the evaluation were recognized from the start. For instance, ORD realized that it was impossible to isolate the effects of the communications modalities from the other components and variables of the developing health program. The evaluation was thus perceived to be limited to a "documentation of activities in an uncontrolled manner," including all the limitations of any field-type study.

The plan that was adopted focused on three related aspects including the clinical applicability of telecommunications technology and the impact of telemedicine on general health status as well as specific illness episodes. The duration of evaluation was planned for 40 months which were concluded in April 1977, encompassing three distinct aspects of evaluative activity comprising 10, 24, and 16 months, respectively. In general, Part One consisted of descriptive analysis of the system and the identification of baseline data and data collection procedures for evaluating the impact of STARPAHC. Part Two dealt with the implementation of STARPAHC and its impact on the health care delivery system, including accessibility, cost and quality of care. The purpose of Part Three was to determine the accomplishments of the project in terms of the original objectives, to describe the health care mechanism which evolved, and finally, to make recommendations for future changes and improvements. In addition, ORD recognized that STARPAHC had provided a "test bed for experimenting with factors external to the project" such as the interrelationships of the various agencies involved, the utility of a common data base, and the ability to integrate both medical information and services from this project with existing resources.

The requirement for this report of the joint planning and development was developed from the original master evaluation plan matrix.

In more detail, Part One of the medical evaluation included narrative descriptions of project objectives, systems deployment, characteristics of the medical service area, existing health care facilities, paramedic guidance development, and service provided. The specific tasks were identified as follows:

1. A description of the complete implementation process of STARPAHC, including explanation of the locations served, types of communication equipment and medical instrumentation, and the various facilities involved;
2. An identification of STARPAHC as viewed by NASA and DHEW;
3. A description of the data to be collected and the sources from which these data were collected;
4. A description of the medical services under consideration in terms of demographic characteristics, existing health care facilities and programs, available providers classified by specialty, distinctive social and medical problems, geography, transportation modes, communication systems, and educational services;
5. An account of the percentage of the population receiving care from various health care organizations;
6. An enumeration of the number of hospital beds available and their occupancy rate;
7. A report of the availability of emergency medical service facilities;
8. A projection of the possible effects on health status of such factors as housing, malnutrition, sanitation, employment, welfare, and mental health problems;
9. An assessment of the effect of any innovations in health care or social system unrelated to STARPAHC which might affect outcomes;
10. A description of the relationship of STARPAHC with IHS;
11. An evaluation of the potential of STARPAHC to interface with EMCRO (Experimental Medical Care Review Organization); and
12. A quasi-experimental design to compare the five STARPAHC villages with the entire Papago Reservation.

Data requirements were identified and then collected from a variety of sources. These sources included: the telecommunications evaluation forms, computer printouts from the Health Information System (HIS), individual patient hardcopy medical records, interviews with the health staff, and the equipment usage log. Forms were completed by health providers, both senders and receivers, for all telemedicine encounters during the study period. In addition to providing utilization and diagnostic data on every patient visit to any site, the computer program provided data on the use of the equipment, the cost of operating each piece of the equipment, and reliability ratios. Furthermore, the patient's hardcopy medical record was analyzed for telemedicine encounters by the Critical Case Review method in order to describe the results of the communication in the total context of the patient's medical problem; service time and travel cost to the patient were also analyzed in this context. Thus, there were three separate data sets for telemedicine encounters: the provider telecommunications evaluation form, system operations information, and the patient visit form.

Part Two was the most elaborate part of the evaluation design. It included both descriptive and quantitative analysis. The descriptive analysis was focused on the following:

1. Identification of the specific health care mechanisms replaced or supplemented by STARPAHC, including any new treatments or tests resulting from the system. A

discussion of the relationship with tribal medicine was also to be provided.

2. The financial sponsorship and means of support beyond the demonstration and test stage that was supported by NASA;
3. The process for initiating change of the medical care guidelines for physician's assistants and RN's and methods for guideline validation;
4. Educational feedback mechanisms, special training, and use of data in defining educational needs; and
5. STARPAHC's influence on provider performance and practice patterns. The quantitative analysis involved a wide range of issues. For example, detailed cost analyses were designed to access planning, consultation, and operational costs. The accuracy and effectiveness of remote services assessed in an analysis which compared the pre-STARPAHC baseline data with STARPAHC initiated data. Included was specific determination of the effect on health status of the service population. The impact of provider productivity was measured, and both patient and provider attitudes were evaluated.

In Part Three, emphasis was placed on analysis of cost. Not only were cost-benefit analysis performed for individual components of the system but the total cost of the system was compared to alternative modes of health care delivery. Of specific interest were: (1.) the cost of on-site physician staffing versus Community Health Medic and allocated communication system costs; (2.) the effectiveness of on-site education via STARPAHC versus periodic return to training centers; and (3.) the effectiveness of remote consultants as contrasted with visiting consultative services or transportation. Issues of system continuance and exportability were also addressed during this stage.

Another aspect of evaluative effort performed by ORD separate from its medical evaluation was concerned with the assessment of the overall impact of STARPAHC on the variety of factors external to the delivery system itself. This ranged from the evolution of working relationships of the various agencies to the potential contribution of HIS and UHDA (Uniform Hospital Discharge Abstracts); also, the potential for relating the experimental STARPAHC project with other communications-oriented health care systems being delivered in Arizona.

NASA had a role in the evaluation of STARPAHC that was focused on space-oriented activities. It had the following objectives in mind:

To provide data for developing health care for future manned spacecraft through:

— further development of the physician-paramedic link
— clinical evaluation of advanced bioinstrumentation
— development of computer support for "remote" health care
— integration of video viewing and display devices
— definition of skills, training and procedural requirements
— evaluation of existing techniques for space application
— identification of technology advancement need areas
— refinement of protocols and techniques

The formal arrangement of the evaluation design and the responsibilities of the various agencies are presented in Figure 17.

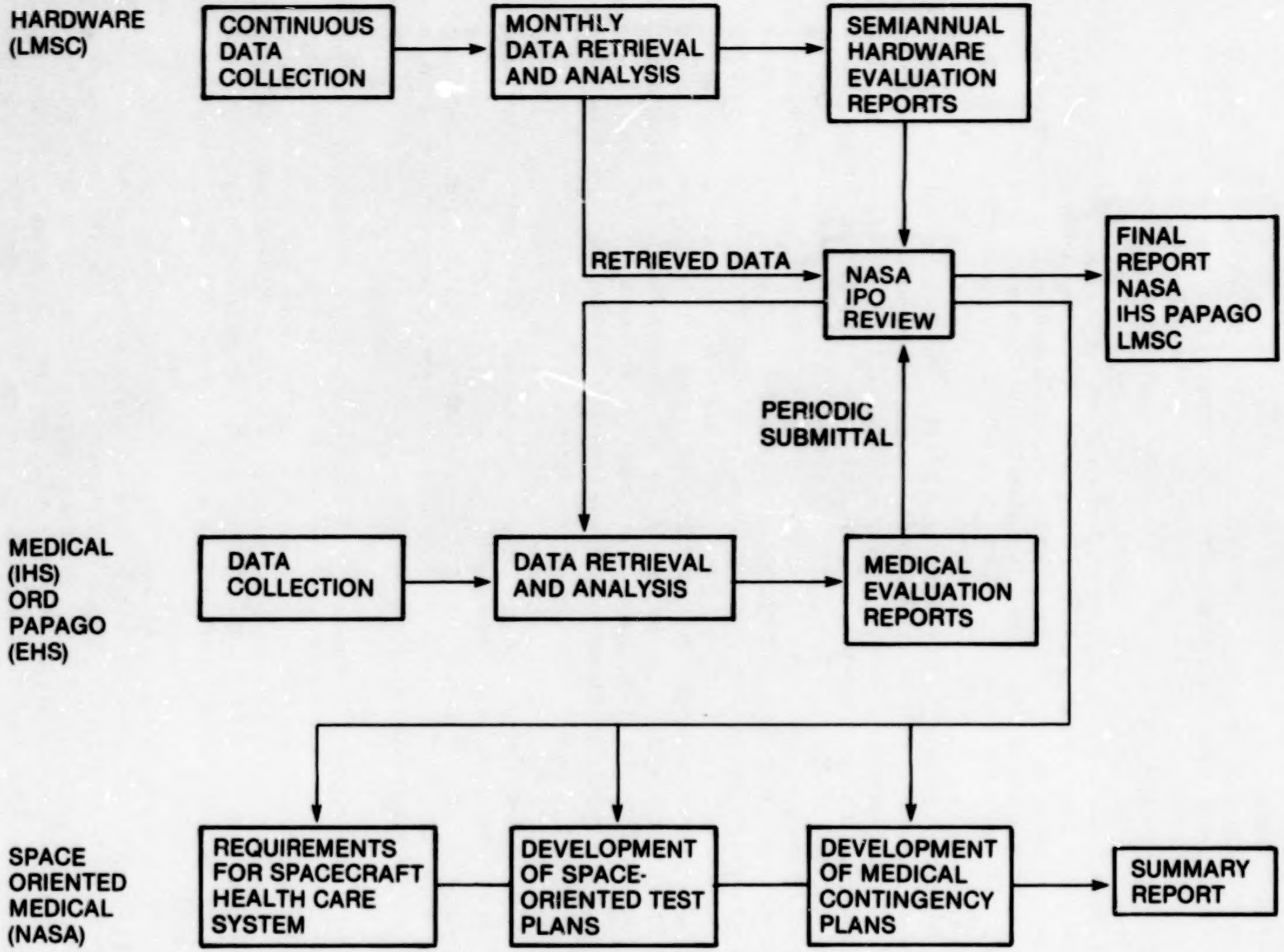

HARDWARE (LMSC)
CONTINUOUS DATA COLLECTION
MONTHLY DATA RETRIEVAL AND ANALYSIS
SEMIANNUAL HARDWARE EVALUATION REPORTS
RETRIEVED DATA
NASA IPO REVIEW
FINAL REPORT NASA IHS PAPAGO LMSC
PERIODIC SUBMITTAL
MEDICAL (IHS) ORD PAPAGO (EHS)
DATA COLLECTION
DATA RETRIEVAL AND ANALYSIS
MEDICAL EVALUATION REPORTS
SPACE ORIENTED MEDICAL (NASA)
REQUIREMENTS FOR SPACECRAFT HEALTH CARE SYSTEM
DEVELOPMENT OF SPACE-ORIENTED TEST PLANS
DEVELOPMENT OF MEDICAL CONTINGENCY PLANS
SUMMARY REPORT

FIGURE 17: Evaluation Information Reporting

The Design Process

The design process resulting in the development of STARPAHC was rather unusual (outside of NASA) in terms of the extent of active participation of all the participants — the Papago, ORD, LMSC, and NASA — and the classic system engineering/management implemented in their development projects. It is, therefore, of interest to highlight the design process.

In general, NASA's procedure for design requirements consists of (1.) an explicit statement of requirements, (2.) the development of a detailed design and specifications to meet the requirements, (3.) building, assembly, training and testing the system, (4.) certification of operation readiness, and (5.) initiation of operations. A review of the design of STARPAHC revealed this same process was followed, and it can be summarized into five basic steps.

1. *General Orientation and Organizational Meeting.* This was the first meeting held following the announcement of site selection, convened in Tucson at ORD. The general nature of the project was reviewed as well as the first set of schedules and deadlines to be met and an explanation of the respective roles of each of the participant organizations. Representatives from NASA, ORD/IHS, Health Resources Administration (HRA) of DHEW, the Papago, and LMSC participated in this meeting. (Since the overall design of the project and the role of the participant organizations had been defined before, one purpose to be served was for the participating organizations to meet face-to-face to reaffirm their commitments.) Another purpose of this meeting was to review the cycle of forthcoming meetings to develop the system design. Briefly, the meetings to come were:

   a. The Preliminary Requirements Review — A review and discussion and further development of system design concepts and requirements.
   b. The Preliminary Design and Review — A review of initial designs and tradeoff studies to meet requirements and concepts.
   c. The Critical Requirements Review — A final review of design concepts, and requirements. The requirements are essentially finalized in order that the final details of the project design could be developed.
   d. The Final Design Review — A final review of design drawings and specifications and installation, training plans, and acceptance criteria prior to commitment to hardware and software manufacture and procurement.

These meetings were essential parts of program definition and design for Phase I of the program. Phase II was system assembly, installation, training, check-out and acceptance testing. Phase III was field site operations and system evaluation. All of these reflect the evolving progressive sequence that constitutes a deliberate and careful NASA approach to the development and operation of a system. Each step went no further than warranted by the available data, definition of design requirements, and the approaches deemed most suitable.

2. *Preliminary Requirements Review.* The same group that attended the general orientation session met at Johnson Space Center in Houston May 9 and 10, 1973. The agenda was prepared by LMSC and consisted of a detailed review of the plans and design requirements for the project. These plans were presented in the program definition report and preliminary requirements report, both prepared by LMSC. This meeting and detailed document review gave all parties an opportunity to review, discuss and come to agreement

about the scope and nature of the program, the system's design requirements, results of problem area studies and possible concepts to meet the requirements. This is before any commitments to specific hardware or designs are made. If action required by one or more parties was identified before an issue could be resolved, the action was entered as a review item for disposition on a master list. The item could only be disposed of by concurrance of all parties that the issue was indeed resolved.

3. *Preliminary Design Review.* The third planning session was conducted in Sunnyvale, California June 27 and 28, 1973 and was attended by all previous participants. LMSC presented its plans for equipment selection and designs. The meeting covered all aspects of STARPAHC design, at all sites on the reservation and included a review of the physician's console and the Mobile Health Unit interior designs. Speciality sessions were held the second day covering communications, computer hardware and software, medical equipment and product assurance. The slow-scan concept for Phoenix linkage was introduced as more cost-effective than the expense of a real-time TV link which would require new relay stations at undeveloped sites in the mountains between Sells and Phoenix. At this meeting it was becoming increasingly obvious that there were differences in interest among the participating organizations. These surfaced as two contrasting points of view; NASA and LMSC were most concerned about hardware and both wanted to have the broadest range and most sophisticated technology that was feasible. The Papago and ORD were most concerned with the manner in which people would be treated, and they emphasized that the health needs of people on the reservation should determine the type of equipment to be acquired. The opportunity to discuss and reconcile differing objectives is precisely the value of this planning process. Some of the ORD staff made request for adding specific patient care equipment. A request for a rotating 45° table for the examining physician was rejected due to space and design limitations. A capability for laboratory work on the Mobile Health Unit was accepted.

4. *Critical Requirements Review.* The purpose of the fourth comprehensive review meeting was to finalize design requirements. All design and operating requirements identified to date and documented were reviewed, changes noted and agreed upon. This meeting was held at LMSC in Sunnyvale, California, August 15, 1973. During this meeting the slow-scan link to Phoenix was confirmed, even though the Papago had requested real-time TV. Three additional relay towers would be required for real-time TV and their installation and maintenance costs were prohibitive. The highest elevations on the mountains were not accessible by road. The problem of power generation for the relay station on the Quijotoa Mountain range was discussed, and a decision made to go with the power company installation, backed by a propane generator.

Most of the changes that were introduced during this stage were of minor significance. The differences between NASA/LMSC and ORD/Papago perspectives were narrowed as the two groups moved toward the other. However, NASA/LMSC continued to seek the design of equipment that would provide the maximum information about the patient in the shortest possible time — such as the microbiologic laboratory at the Mobile Health Unit. Some ORD and Papago staff were concerned about the potential health hazards of this arrangement.

5. *Critical Design Review.* A critical design review meeting was held at LMSC Sunnyvale, California, November 13, 14, and 15, 1973. During this meeting the final design configurations were analyzed, aided by full scale mockups of the major parts of the system such as the physician's console and a full-scale Mobile Health Unit interior mock-up.

Subsequent to this review, Papago representatives offered an important design change of the Mobile Health Unit in order to achieve patient privacy during clinical encounters. Entrance to the Mobile Health Unit could permit cross traffic through the patient examination room in the original design. At their suggestion, the entrance was changed to the receiving area from which the patient alone can go to the examination room. The following comparative diagrams show the original and the Papago designs:

LMSC DESIGN

X-ray	Exam	Reception Lab HIS
EXIT		ENTRANCE

PAPAGO DESIGN

X-ray	Reception Lab HIS	Exam
	ENTRANCE & EXIT	EMERGENCY EXIT

The X-ray table was also replaced with an examination table thereby providing a second examination table capability in the X-ray room.

During this meeting, the routing of the Mobile Health Unit was confirmed, at the suggestion of the Papago, to cover the western districts which were the most remote and least-served areas in the reservation. Specific village stops were also identified by the Papago. Other design and operational details which were worked out for the Mobile Health Unit included capacity of the water-holding tank (Papagos insisted it be larger) and service stops for water intake and waste disposal. Other potential problems diagnosed included dust and adequacy of lighting for cameras at the Mobile Health Unit.

Finally, a detailed report of the total design configuration and all the specifications was prepared by LMSC for review and final approval. In this brief review of the design process many details of design issues and definition have not been included. What has been emphasized is the process that permitted the participants to blend their special knowledge and capabilities into a successful design and operation of a complex telemedicine system. At each meeting documents describing the overall system definition, operations plan and design of each component and locations were reviewed by all participants. These included the Mobile Health Unit, the relay tower, the hospitals at Sells and Phoenix, the health center at Santa Rosa and all of their associated personnel, and hardware as well as their operational, transport and communications linkages. These documents became increasingly definitive as the process proceeded. At each meeting the participants reviewed, discussed, debated and came to an agreement of design and operations details.

While this concluded the design process, NASA had also stipulated that LMSC provide operational readiness certification and operate the system for two years.

The project was operated by LMSC and the Indian Health Service in conjunction with the Papago Tribe starting in May, 1975. The process initiated in design continued through manufacturing installation test and check-out as well as throughout the operational test and evaluation to the final transfer of the system from NASA to IHS in May, 1977.

Summary and Conclusions

While each of the participating organizations in the STARPAHC Project had its own interests, they cooperated, and through joint efforts, produced a system that was superior to what any one of them could have developed alone. NASA's mission was clearly space exploration. Equally relevant to NASA's goals, however, were spinoffs from its technology to the private sector. Hence, there were dual purposes to be served by this project. NASA, therefore, had a strong incentive to get involved in telemedicine applications on earth, both as a test bed for advanced technology and commercially available equipment for future long duration manned space flight as well as for earthbound applications.

The ORD/IHS seized the opportunity to experiment with innovative systems that could reduce problems of access, assure quality and/or decrease cost of care to its service population and expand the scope of health care availability to the Papago people.

Once assured of their input into the design, control and ultimate disposition of the project, the Papago were happy to receive the project. Their satisfaction continued because the promises made for their full participation were honored, and their preferences were respected by the "outsiders" who came to the reservation.

LMSC was able to maintain its vital role in NASA's space program while eyeing a potential market for telemedicine at home and abroad. Its major frustration came from a drastic reduction in the budget made by NASA Headquarters prior to site selection.

Interestingly, all the participant organizations had a stake in the successful completion on the project lest none would have the part they most wanted. Thus, they developed an attitude of accommodation toward each other, realizing perhaps that the participation of everyone was necessary for the ultimate success of the project, and a process was employed which permitted all participants to participate in the design.

It may be appreciated that NASA's mission requires extremely high realiability of their equipment and technology and thus costly hardware. High risks for human and material loss that are very much in the public eye are a primary concern. Therefore, in order to reduce both the risk and the cost, NASA had developed a precise design and implementation process. A chief function of this process is to reduce the level of uncertainty to a minimum. It was this design process that was applied to STARPAHC. Namely, to actively involve all the participating organizations and to treat them as responsible partners in a joint effort. New to NASA, was the inclusion of an Indian tribe as a partner or any community of user's participation (except for astronauts).

During the developmental stages of the idea of the project, an agreement was reached between NASA and DHEW to jointly sponsor a test and demonstration project of NASA's concept, whereby DHEW would provide nominal support for the medical evaluation and NASA all the rest. DHEW was also to lead the site selection process. After the Papago Reservation was chosen as the site, the Division of Health Care Technology (at the time a heavy supporter of telemedicine projects), planned to issue a sole source contract to the University of Arizona to conduct a comprehensive evaluation of STARPAHC. The University's track record in telemedicine, their geographic proximity and the ongoing working relationship with both the ORD and the Papago were cited as justifications for the sole source procurement. However, DHEW withdrew its initial offer of support for the medicial evaluation (a mere $37,000) and instead offered a plan for medical evaluation that was never delivered. Similarly, the Division of Health Care Technology which had supported seven exploratory telemedicine projects in various parts of the country could not secure the approval of the proper authorities for funding. Thus, support was withdrawn from the Office of the Assistant Secretary of DHEW and from the Office of the Director of the National Center for Health Services Research. The reasons were never made public.

Nonetheless, the Office of Undersecretary did maintain a link with the project.

Such was not the case with the IHS/ORD. With the selection of the Papago Tribe, the ORD provided continuous support for the project. However, the ORD was in turn frustrated with the Health Resources Administration, for lack of support or cooperation in the evaluation despite repeated affirmations. The ORD had preferred an outside organization to conduct the evaluation, since its own conclusions might be regarded as suspect. But, it was soon realized that there would not be a medical evaluation suitable for health care delivery issues unless the ORD did it.

Frequent organization shifts within the Public Health Service during and beyond the developmental period of this project make it rather difficult to maintain proper reference to specific organizational units. Indeed, it seems that while most of the same personnel remained, the organizational structure changed significantly. For STARPAHC, the most crucial change was the reorganization of HSMHA and the Bureau of Health Services Research and Evaluation, and the establishment of the National Center for Health Services Research. Concurrent with this change in administrative structure, there was also a change of attitude toward this project, possibly as a result of the relocation of personnel and shifts in power.

The medical evaluation was fully implemented by the ORD on the basis of its bimodal design and implementation process. LMSC was charged with hardware evaluation, and NASA conducted its own medical evaluation. ORD's medical evaluation was focused on the impact of use of STARPAHC equipment upon patient care, whereas LMSC's hardware evaluation assessed the performance and use of various pieces of equipment and their total configuration. One crucial purpose of evaluation for ORD was the determination of the costs and benefits of continuing the system in its present or a modified form. Finally, the Papago had a system that improved access to health services on the most isolated and remote districts of the reservation and had learned a great deal about system design from being intimately involved in the development of a high technology health care support system on their lands. For instance, the favorable experience the Papago had in this project was probably instrumental in their acceptance of two other high technology NASA projects on the reservation. These projects originated in other NASA centers, and involved the provision of solar energy for an entire village in the remote western districts and a solar powered refrigerator, for another village. Interestingly, NASA in turn has continued to work with other communities in other parts of the country. It can be reasonably assumed that they too had learned from this experience.

Chapter Six
SUMMARY AND CONCLUSIONS

Introduction

In the story of STARPAHC, we have traced the genesis of the telemedicine concept at NASA, given a brief account of the history of the Indian Health Service and the activities of the Office of Research and Development, presented the culture and aspirations of the Papago people, and described the basic processes leading to the design, implementation and evaluation of this project. Our primary purpose has been to document the historical evolution of STARPAHC as an example of a successful co-operative project that involved the confluence of several organizations and groups, including NASA, IHS/ORD and the Papago. Indeed, one of the most striking aspects of this project that brought advanced space age technology to remote parts of the Papago Reservation was the development of a productive functional relationship among the participating public agencies and the private sector. While each of these groups might have started with a different perspective and specific goals suitable for its own mission, their mutual experience on this project seems to have created a shared perspective regarding the proper use of telecommunications technology in remote health care and the necessary role of the service population in the design and implementation of such systems. They adopted a common belief that the telemedicine concept had real merit not only for the Papago Reservation in overcoming accessibility problems but also for other areas in the United States and other countries suffering from a maldistribution of medical resources or an inability to reach all segments of the population with quality care.

From the beginning of the effort leading to this report, it became obvious that the story of STARPAHC involved the fitting together of several separate pieces, and hence many of the research activities in this endeavor were aimed at obtaining the necessary information from the original sources about each of these major pieces. In addition to personal interviews, written documents from the files of the Indian Health Service, Office of Research and Development and those of the National Aeronautic and Space Administration were scrutinized. Leads on important points were followed in order to establish meaningful connections between the various pieces. The experience proved to be both rewarding and instructive, for it revealed a success story that is worth telling. Though confined primarily to techical design and major decision points, the level of documentation on the part of these agencies was impressive. This report is a modest effort at pulling the major pieces together to give a comprehensive picture of a concerted effort on the part of these agencies and the Papago people.

It may be appreciated that telemedicine has bèen tried in other parts of the country with mixed results, albeit at a smaller scale and with lesser resources. Hence, the results of this experience with telemedicine — where the resources and the scale were of sufficient size to enable meaningful evaluations — could have serious effects on the future of telemedicine, at least in the foreseeable future. There is currently a setback in the funding of telemedicine projects in the United States; there is also a confusion regarding the true merits of telemedicine. Both of these may be influenced by definitive findings from STARPAHC studies. The level of funding may be increased in the face of strong positive findings that demonstrate unique benefits such as increases in accessability to care at reasonable cost, but it may also be further reduced as a result of insignificant findings.

Many of the other telemedicine projects prematurely folded before reaching a steady operational state to enable a reliable assessment of their capability, benefits, and costs. Many suffered from insufficient planning, inadequate designs, and improper definition of objectives. Many were judged too early without full recognition of the limitations in their design or the constraints in the environmental settings in which they were established. In view of these facts, it is fair to say that the telemedicine concept remains inadequately tested to date. What makes matters worse is that because of the wasted resources on poorly conceived and inadequately implemented experimental projects, the word was out prematurely against telemedicine, doubting its cost-effectiveness. Unfortunately and as might be expected, such negative views had a stifling effect on research and demonstration activity in these areas.

Important lessons have been learned from STARPAHC, and they deserve wide dissemination. Those interested in telemedicine should review the various reports coming out of this project.* Perhaps where other evaluations have failed due to various constraints, the results of STARPAHC evaluation will prove instructive concerning the benefits and cost-effectiveness of telemedicine. However, this report is not an evaluation of STARPAHC, rather it is a documentary report on its development. To be sure, the issues surrounding evaluation are probably the most important ones to be considered. But irrespective of their significance, in terms of what they might reflect about the merits and problems of telemedicine, STARPAHC is an important story whose success is attributable to the cooperation among public and private groups in an innovative undertaking. Indeed, the commitment on the parts of providers and consumers alike for the success of this effort, and the application of sophisticated system design goes a long way to explain that success. All these aspects were described in some detail in the previous chapters. What is worth repeating here is the fact that the telecommunication capability of telemedicine was superimposed on an existing health care system, and while the importance of the various planning, design and implementation activities has been duly recognized, the existence of an ongoing delivery organization on the reservation together with a sophisticated health information system prior to the introduction of STARPAHC should be emphasized. This was not only crucial for the selection of this particular site for the IMBLMS/AHSFU test bed but also for assuring the success of the effort. Indeed, when viewed in proper perspective, the technological components contained in telemedicine constitute only a part of the larger health care system that was already in place on the reservation. As anticipated and planned, the technology was utilized to enhance the ability of the health care system to reach more people in a more efficient manner than was possible without it.

A Brief History of Telemedicine

The history of telemedicine represents the confluence of two somewhat autonomous developments in telecommunications. The first root lies in the manned space flight program and in the development of sophisticated technologies for biomedical telemetry and communication in space. The second development stems from the telecommunications industry in the private sector. In medical care, much of this latter growth is reflected in the expansion of telecommunications in health data processing. In medicine it is largely reflected in use of closed circuit systems in medical education and in continuing education.

The development and demonstration of the capabilities of telecommunications equipment for remote biomedical telemetry were major achievements of the space program. At the beginning, NASA's scientists were concerned with the physiological effects of zero-gravity upon astronauts. Initial constant monitoring of heart rate, blood pressure, respiration rate, temperature, and other functions were consequently reduced to periods of high stress or activity. Longer flight times and anticipation of continuously staffed orbital stations led NASA to develop capabilities for diagnosing and treating in-flight medical emergencies, systems for maintaining health levels, and capabilities for biomedical research and experimentation. Direct application of experience and development in space research can be found in medical care today. One of the most exemplary cases is the widespread use of paramedical teams of the cardiac monitoring and resuscitation package developed by NASA.

---

*See list of publications in Appendix.

Telemedicine is not solely a descendent of the space program. Even before television became widely available on a commercial basis, closed circuit transmission of surgical procedures and class room instruction via cable television were to be found in medical schools and hospitals. By 1960, the first interactive video link, providing two-way voice and visual contact was established between the Nebraska Psychiatric Institute in Omaha and the Norfolk State Hospital 112 miles away.

A major consideration of these early systems was what clinical functions were adaptable to telecommunications. Early efforts concerned themselves to a large degree with the adaptation of commercially available equipment to the clinical setting. While the promise of telemedicine, particularly the use of interactive television, was apparent, constraints were also present. Equipment reliability and maintenance costs were significant problems. Equipment performance was such that strictly controlled studio conditions were necessary to achieve reliable transmission. These constraints made the first telemedicine program demonstrations uncertain and the clinical encounters artificial in nature.

Despite their uncertainties, these early programs demonstrated that there were recognizable clinical advantages and disadvantages in the use of telemedicine. Particular insights were gained into what organizational, technical, and staffing arrangements would result in optimizing benefits from its use. Equipment needed to be more reliable, less constraining in its operation, and less intrusive in the clinical encounter. As well, it was quickly realized that new health practitioners, working with established protocols, and having the facility to communicate with remote physicians, enhanced and expanded the capabilities of the single physician. It was this model which served for nearly every telemedicine system which followed.

The criteria for optimal telemedicine systems and the conditions for their use which emerged from these initial experiences were: (1.) where there were integrated systems for the delivery of medical care to multiple delivery sites; (2.) several physicians working in a concert as a group; (3.) the use of non-physician providers with extended clinical functions and direct responsibility to the patient; and (4.) settings where personal encounters between patient and physician were not a viable option by other means.

The early stage of telemedicine development was characterized by the pioneering efforts of a few individuals drawing on personal and organizational resources and with little public or private financial support of their efforts. The second stage, between approximately 1965 and 1973, consisted of a deliberate effort toward research and development of the potential of telemedicine and was expanded by the infusion of short-term federal support. Indeed, due to the substantial capital investment required and the high maintenance costs involved, it was not possible to realize organized, comprehensive telemedicine projects except as federally supported demonstrations. Seven projects were funded by the Department of Health, Education and Welfare, two by the National Science Foundation, and one by the former Office of Economic Opportunity during that period.

It was expected that in three years or less it would be possible to determine whether telemedicine was a viable option for comprehensive health care delivery, how cost-effective it was compared to other delivery mechanisms, how well it would be accepted by clients and providers, and what types of links, transmission, display, and equipment would be most suitable.

While early findings concerning clinical aspects were reaffirmed, the hoped for findings with respect to the more general questions of applicability, effectiveness, and efficiency were not realized. Initial costs were so high and federal support so limited that many projects cut back on the patient populations served or on the comprehensiveness of the care delivered over the system. The generalizability of the findings was severely limited as a consequence. Failures, both hardware and human, marred evaluation in many instances.

The third stage of telemedicine began around 1973 with active involvement in evaluation by interdisciplinary teams. For the first time social scientists and specialists in medical care organization, planning, and delivery were included in the effort. The first of a planned series of national conferences brought together researchers, users, designers, and industry representatives to share experiences, plans and findings.

It was during this time, that a cooperative effort at a comprehensive telemedicine demonstration and evaluation was occurring in the form of STARPAHC. As reported in this story, STARPAHC was a consortium of medical care providers and the space industry, of public and private interests. Conceived and sponsored by NASA, assembled by Lockheed Missiles and Space Corporation, managed and evaluated by the U.S. Indian Health Service, and utilized and evaluated by the Papago Nation. The unique attributes of this project were described earlier. It utilized the most advanced technology available from the public and private sectors. Both hardware and human systems engineering expertise from the space program were applied to an earthbound problem of delivering medical care services on the Papago Indian Reservation. Extensive evaluation criteria, decision points, and bench mark tests were developed during the initial planning stage. Existing capabilities such as the Indian Health Service's computer-based Health Information System were integrated into its design. Tribal members were recruited and trained to be the front-line care providers. Lastly, all relevant actors, including the potential recipients — the Papago People — were actively involved in determining the system's objectives, its basic design, the criteria for performance, and authority and responsibility for its operation.

As described earlier, STARPAHC provides a full communications range, two-way television, audio and data communications between the central station at Sells on the Papago Reservation and a fixed site satellite clinic at Santa Rosa, a regularly scheduled mobile health clinic, and a full-facility hospital-based clinic at Phoenix.

The medical care needs of NASA's manned space program led to the development of telemetry and remote monitoring equipment suitable for its own purposes. Some of that technology adaptable for terrestrial usage would have probably found its way to the marketplace sooner or later. What pushed the telemedicine idea was the request of the President's Domestic Council to combat the nation's basic problems. NASA's response in the health care area was a proposed national telemedicine network with regional and local subdivisions. The telemedicine concept was readily perceived as a parallel between the provision of medical services to astronauts travelling in space from a command station on earth and a dispersed population tens of miles away from a central facility.

In order to adapt this concept to an earthbound situation and to design complete systems for long duration space flights, many problems had to be overcome and more had to be learned about the operation of such systems. Moreover, the success of the test required the cooperation of appropriate agencies of the Department of Health, Education, and Welfare, the target community and private industry.

The original design of STARPAHC was predicated on the assumption that a full test model, including the most appropriate technology, was to be installed. It included a sophisticated system capable of remote diagnosis and consultation with fully equipped mobile and fixed satellite stations. But there were significant budgetary reductions that also meant reductions in the scope of the project and the technology that could be developed for this purpose. The most significant implication was the limitation to existing technology available from suppliers. It can only be conjectured now what technologic improvements could have been added to the system with more liberal budgeting. It is possible that certain delays could have been averted, and higher reliability probably achieved with equipment specifically designed to meet environmental requirements.

Now that several research reports have been issued from the other telemedicine projects in the country, there is a growing body of knowledge, despite the imperfections, concerning the efficacy of telemedicine as a new mode for the delivery of health service. Data on the evaluation of STARPAHC has been issued separately in various forms. By virtue of its size and sophistication, what will be reported by STARPAHC will influence the future of telemedicine at least in the long run. Evaluations of other telemedicine projects have yielded mostly inconclusive results, and many had data of dubious quality. Moreover, some of the reported findings were made with inadequate study designs, insufficient duration of experience or simply a lack of meaningful hypotheses that were set up for testing purposes.

Although opinion about the actual results of the experience with telemedicine might vary, the following shortcomings can be pointed out.

1. *Time-related problems:* The time period for the research and demonstration projects was simply insufficient to reach definitive conclusions regarding the real merits of telemedicine, particularly in terms of its cost-effectiveness in relation to other modes of health service delivery. Strangely, projects were required by the funding agencies to produce evaluative performance data while they were still struggling to get the equipment to work reliably and while the providers were getting used to the new technology that required certain behavioral adaptations on their part in the use of the new medium. A clinical encounter with a patient over television is different from a person to person encounter. The providers had to learn how to communicate through the television medium and how to get the necessary information for diagnosis and treatment. In fact, none of these projects had reached a steady state of operational performance at optimal or even reasonable patient load levels to justify meaningful cost-effectiveness analysis. It may be appreciated that in a technologically based system such as this, the capital investment may only be recovered over an extended period of time of steady operation. Consequently, if the system is to be self-supporting, the high cost of the equipment has to be distributed over a large number of patients who receive their care through telemedicine.

2. *Design-related problems:* Due to the constraints created, perhaps inadvertently, by the funding agencies, several projects set up awkward experimental situations that limited the generalizability of the data from them. In addition to the novelty effects, there were incongruent arrangements that seriously jeopardized the research efforts. For example, cameras were located at an angle with the physician so that the patient would see him/her "looking away"; the telecommunication equipment was located in places not readily

accessible to the physicians, no match for the ubiquitous telephone.

Perhaps more importantly, there was very little input from competent engineers and communications specialists in the design of these systems. Equipment was purchased "off the shelf" often intended for broadcast use under controlled studio environments that are not readily replicable in medical practice. Moreover, technical failure in the relay equipment often interfered with the more serious issues at hand. Much of the early effort was directed at making the equipment work rather than finding out what the equipment is capable of performing.

3. *Problems related to objectives:* The evaluation efforts during this period also suffered from a lack of clearly defined objectives that would serve as evaluation parameters. In many programs, it was not clear whether telemedicine was intended to supplement, enhance or replace the existing delivery systems. Moreover, there was no distinction between short term and long term goals, and no clear statement of hypotheses derived from these objectives. Therefore, much of the evaluation activity during this period did not address the crucial issues of the benefits of telemedicine. Hence, it was not reasonable to expect that these early projects would yield definitive findings regarding the merit or cost effectiveness of telemedicine.

It is very important to discuss the limitations of the reported findings because most of them were inconclusive and some were disparaging. Yet despite the limitations of the studies and the inconclusiveness of the findings, policy makers decided to curtail funding telemedicine projects with disastrous results on its development at least in the foreseeable future. Policy makers have become increasingly cynical about the utility of technology in general, and the funding of technologically-based innovations or systems was discouraged. It was ironic in the case of telemedicine that the public investment in the developmental activities was wasted without reaching definitive conclusions about its merit. It was as if telemedicine was fashionable at one time, but like all other fashion, its time has passed, and its practitioners, promoters, and evaluators have moved into bigger and better things.

The major questions about telemedicine were raised in terms of its cost effectiveness in comparison to traditional arrangements, i.e., does it produce more or better services at the same cost or the same set of services at reduced cost? Thus, at least in the short run, the answer may lie in the proper technology-manpower-organization configurations that could yield the most diversified health services at minimal or acceptable levels of cost. While this will not seriously address the question of cost effectiveness of telemedicine, it does provide a basis for an adequate evaluation of it, since the purpose of such evaluation should deal with the benefits and costs of the optimal feasible arrangements in telemedicine and not the limitations reflected in the demonstration projects. That is to say, we need to know what the best technology-manpower-organization configuration is capable of delivering rather than what we lose under imperfect applications of telemedicine.

Future Prospects

Though unique in some respects, the STARPAHC story provides direction and insight valuable beyond its own immediate experience that is also exportable to those who undertake other similar types of projects and programs in other places in the United States and in other countries. At the same time, many questions concerning the benefits of telemedicine and its appropriateness as a new mode of medical care delivery must be deferred and only tentative conclusions drawn at this time. It is certainly reasonable to expect that some form of telemedicine is an invariant pattern of the future, that it is very likely that this level of technology will penetrate into the delivery organizations in some form or the other. Of course, the specific applications of the technology may take different forms depending on a variety of factors that include cost, efficacy, and versatility.

It is important to know why STARPAHC proved to be a success whereas other projects either failed or had limited achievements. But answers and conclusions to a larger set of questions concerning the efficacy of telemedicine must necessarily await the developments in the coming years. Moreover, the unique history of STARPAHC must also be viewed as an instant in the larger histories of space flight and medical delivery. Its role and importance, of course, are determined by and are as varied as the specificity and scale of the historical inquiry applied. STARPAHC's influence on the histories of the Papago, telemedicine, and NASA is much greater than its impact on space flight and medical care delivery. The major, and, we feel, appropriate emphasis as with the entire narrative is directed toward the major STARPAHC actors—but a final larger perspective is also presented.

NASA's concept of telemedicine as a regionalized national network was not fully tested in STARPAHC, despite the fact this project represented the essential nucleus of the larger network. NASA envisaged a master plan that would cover the whole nation in a partnership with DHEW. But, before this can be put into effect, it was necessary to have a test site in which the concept would be fully tested and necessary changes be made for wider implementation, both in space and on earth. Thus, while administering an earthbound application, NASA was adhering to its primary mission of space exploration. It has viewed earthbound applications as fruitful spinoffs of its space technology.

Of the various uses of telemedicine such as education, consultation and conferencing, STARPAHC was largely confined to remote diagnosis utilizing the Mobile Health Clinic (see Figure 18 for a picture of the interior of the MHU) and the fixed Satellite Clinic. That is why telemedicine was viewed as particularly appropriate for rural areas that normally suffer from doctor shortage. Nonetheless, the telecommunication link between Sells Service Unit on the Reservation and the Phoenix Indian Medical Center that provides consultation among physicians, i.e., teleconsultation, may prove to be the most successful model for future telemedicine for the following reasons: (1.) in terms of cost, it used the least expensive technology (audio link and slow-scan TV); (2.) in terms of quality, it provided an opportunity to have a "second opinion" for diagnostic purposes and clinical decision making as well as specialist consultation done rapidly and efficiently; (3.) in terms of equity, there were no distinctions made between patients such as sorting of patients by those who can have face to face encounters with physicians and others who should rely on telemedicine as a second choice; and (4.) in terms of acceptance, both providers and patients were happy to have it.

The Indian Health Service was primarily interested in assessing the benefits and costs of STARPAHC for the health delivery system in terms of services received and services required; its effects on accessibility and use of service, as well as its ultimate impact on the health status of its service population. The answers it has obtained to these kinds of questions should be of great interest to policy makers, providers, and the public at large.

For the Papago people, STARPAHC opened a window to a larger more technologically sophisticated world, as well as an exposure of their own culture and way of life to several outsiders. As a result of this experience, they feel their lives have been enriched without being forced to alter their lifestyle or values. The Papago were gratified to find out that they could be taken seriously in technical matters — that they could make contributions to the design of complex technological systems if only to reflect the needs of their culture and their way of life.

Figure 18: Papago Leaders Inspect the Interior of the Mobile Health Unit.

There is no question about the benefits accrued by the Papago People. STARPAHC brought space age technology to their reservation, and it helped them meet acute needs for communication links both within the reservation and between the reservation and the outside world. Remote areas in the reservation acquired the Mobile Health Unit with its personnel thereby obviating the need for a long and cumbersome trip to see the doctor.

For its part, and because of the need to explain the use of its space technology on earth, NASA probably gained greater appreciation of the importance of community involvement for technology transfer.

Through STARPAHC, NASA and the Indian Health Service have demonstrated an organizational and technological capacity to effectively provide medical care delivery to dispersed and remote populations. The systems approach to the design and implementation of this mode of medical care delivery has proved effective and holds promise for other situations. Yet the relative success of STARPAHC must be tempered by the specific conditions under which the project was conducted. The existence of geographically distinct yet socially and culturally homogeneous populations are rare in this country. These characteristics of the Papago, in addition to their expressed willingness to cooperate in the project, the legal status, and acceptance of paraprofessionals on the reservation, and the extant Health Information System would make this situation difficult to replicate. Some of the findings from this project may not be generalizable to other areas. Consequently, the major success of the project from NASA's perspective must be in the technical experiments and the demonstration of the efficacy of remote telemetry and non-physician medical personnel in the provision of medical care. Certainly valuable experience has been gained by NASA that will contribute to its capability of providing medical information and care to personnel in space. At the same time NASA expressed early that perhaps a regional and even national network might be feasible if the experiment was a success. This assumption—or expectation based solely upon one experiment in a somewhat unique setting—was probably unrealistic and perhaps reflects a limited perspective with which NASA initially viewed medical care delivery in the United States.

It should be pointed out, however, that this limited perspective was more than offset by the demonstrated competence of NASA in dealing with the technical design of the project, in cooperating with the indigenous population and adapting to the ways of the Indian Health Service in dealing with its service population. The cooperation and advance planning on the part of all the participants in this project can serve well as a model for others whose telemedicine projects have failed for lack of recognition of the necessity of such cooperation and of community involvement in the planning and design of medical care delivery systems appropriate to particular populations. It may well be that in the final analysis a modified STARPAHC approach and model may well serve as a basic format for at least one type of medical care in our pluralistic society.

Figure 19: The STARPAHC Operator's Console

Appendix

Publications About STARPAHC

I. Descriptive

1. "Aerospace Technology Accents Health Care 'to go'", International Trail, Vol. 45, No. 3, 1975.
2. "Coming: The Era of Telemedicine," IEEE Spectrum, p. 31.36, December, 1976.
3. "Health Care Via TV in a Rural Area," U.S. News & World Report, pg. 79-80, December 26, 1977/January 2, 1978.
4. "Innovations in Medicine," Spinoff, NASA publication, pgs. 50-53, 1977.
5. "Japanese Space — TV Gear Aids Treatment of U.S. Indians," Electronics, pg. 59, April 15, 1976.
6. Levine, Mark D. "Is Your Medicine Chest Ready for Bio-Electronics?" San Jose Magazine, pg. 47-49, December/January, 1979.
7. Rockoff, Maxine L., PH.D. "Technology in Rural Health Care," Committment, Vol. 2, No. 4, DHEW, PHS, HSA, Health Services Administration, Fall, 1977.
8. Serven, James E. "A Dividend From the Space Program, NASA Technology Pays Off in Arizona," Arizona Highways, pgs. 46-47, February, 1975.
9. "Space Technology in Remote Health Care," NASA publication, JSC #09161, August, 1974.
10. "STARPAHC Mobile Health Unit," Computers and Medicine, Vol. V, No. 2. March/April, 1976.
11. "STARPAHC," Presentation to the Royal Society of Medicine, Leyden, The Netherlands, Pool., S.L.; Johnston, R.S., NASA Technical Library, JSC, Houston, October 11, 1974.

II. Evaluative

1. Fuchs, Michael, PH.D., "Provider Attitudes Toward STARPAHC — A Telemedicine Project on the Papago Reservation," Medical Care, Vol. 17, No. 1, pgs. 59-68, January, 1979.
2. Henceroth, Stan "An Application of Decision Modeling to Indian Health Care," Interfaces, Vol. 9, No. 1, pgs. 18-24, November, 1978.
3. Justice, J.W. "Report on the First National Symposium on the Medical Uses of a Portable X-Ray Imaging Instrument: The Lixiscope," Arizona Medicine, January, 1979.
4. Justice, J.W., Decker, P.G. "Telemedicine in a Rural Health Delivery System, Advances in Biomedical Engineering, Vol. 7, pgs. 101-169, Academic Press, 1978.
5. STARPAHC Systems Report," Vol. I and II, NASA Technical Library, Johnson Space Center, Houston, Texas, NASA-CR-151578, NASA-CR-151579, LMSC-D566138, October, 1977.

☆ U.S. GOVERNMENT PRINTING OFFICE 1980 — 685-823

90%

50%

END

8 -23-81